

DOMESTIC ARCHITECTURE

L. EUGENE ROBINSON



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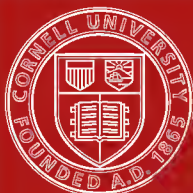
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DOMESTIC ARCHITECTURE



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Domestic Architecture



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THIS BOOK IS DEDICATED IN LOVE
TO MY BABY GIRL
WHO I TRUST WILL SOME DAY ASPIRE TO THE
NOBLEST CALLING OF WOMANKIND,
THAT OF HOME MAKING

PREFACE

ALTHOUGH to some the word architecture may suggest pretentiousness, the contents of this book will be found to relate to simple everyday things pertaining to houses. The work is intended for all who are interested in house problems. It considers both the design and construction of the building itself and also a number of related topics such as the selection and development of the site and to some extent the equipment and decoration of the interior. It is hoped that it will be found useful to all who are so fortunate as to be able to build or remodel their own houses and that it may be of special service to those who, like the author, are interested in the teaching of the house to students in colleges or in schools of home economics. To increase the practical usefulness of the book, chapters on the cost of dwellings and on the relations of the owner to the architect and to the builder have been included.

L. E. R.

TABLE OF CONTENTS

PART I.—A TEXT-BOOK

	PAGE
CHAPTER I. HISTORY OF DOMESTIC ARCHITECTURE.....	I
Shelter—The Æsthetic Sense—Prehistoric Structures—Egyptian Dwellings—Western Asiatic Domestic Architecture—Greek Domestic Architecture—Roman Domestic Architecture—Early European Domestic Architecture—Renaissance Architecture—Conclusion—Sketch Problems—References.	
CHAPTER II. DOMESTIC ARCHITECTURE IN THE UNITED STATES	23
Dwellings of Pioneers—Georgian or Colonial Architecture—Colonial Architecture in New England—Colonial Architecture in the Middle Colonies—Colonial Architecture in the South—Spanish Architecture in the South—Late Developments—Future Houses—Sketch Problems—References.	
CHAPTER III. BUILDING SITES.....	40
General Considerations—Public Utilities—Conveniences—Natural Advantages—City Lots—Suburban Lots—Sites for Country Places—Farm Sites—Sketch Problems—References.	
CHAPTER IV. HOUSE DESIGN.....	51
General Considerations—Types of Plans—Individuality—Character of Exteriors—The Geometry of Plans—Composition—Arrangement of Rooms—Living Apartments—Sleeping Apartments and Accessories—Dining and Cooking Apartments—Kitchen for the Very Small Suburban House—Kitchen for the Large Suburban House—Kitchen for a Farmhouse—Rooms for Servants or Hired Help—Porches and Exterior Features — Basements — Conclusion — Sketch Problems—References.	

TABLE OF CONTENTS

	PAGE
CHAPTER V. INTERIOR DESIGN AND ARCHITECTURAL FURNITURE.....	87
Room Design—Doors and Windows—Trim—Architectural Furniture—The Living Room—Bedrooms—Dining Rooms—Kitchens—Conclusion—Sketch Problems—References.	
CHAPTER VI. CHARACTER AND MOULDINGS.....	117
Architectural Character—Classical Mouldings—Orders of Architecture—The Tuscan Order—The Doric Order—The Ionic Order—The Corinthian Order—The Composite Order—The Use of the Orders—Eccentric Mouldings and Ornament—Character of Colonial Houses—Character of Miscellaneous Styles—Sanitary Mouldings and Treatment—Conclusion—Sketch Problems—References.	
CHAPTER VII. COMMON BUILDING MATERIALS.....	133
Building Stones—Bricks—Terra Cotta—Tiles—Concrete—Wood—Steel and Iron—Sheathing Paper and Deadening Quilts—Sketch Problems—References.	
CHAPTER VIII. FINISH BUILDING MATERIALS.....	163
Scope—Materials Used to Make Plaster, Mortar and Concrete—Finish Woods—Finish Hardware—Paint, Enamel, Varnish and Stain—Tile, Brick and Terra Cotta for Facing—Glass—Sketch Problems—References.	
CHAPTER IX. HOUSE CONSTRUCTION	174
Kinds—Methods of Procedure—Staking out the Building—Excavation and Grading—Masonry—Wood Framing—Exterior Finish—Sketch Problems—References.	
CHAPTER X. INTERIOR FINISH.....	192
Lathe and Plaster—Interior Woodwork—Put-	

TABLE OF CONTENTS

PAGE

ting on of Hardware—Painting, Varnishing and Staining—Glazing—The Completed House—Sketch Problems—References.

CHAPTER XI. INTERIOR DECORATION AND TREATMENT OF SURFACES..... 203

Introduction—Color—Period Decoration—Decorative Materials—Wood Treatments—Plaster Treatments—Ornamental Glass, Tile, Metal, etc.—The Living Rooms of a House—Bedrooms—Kitchen Treatments—Bathroom Treatments—Porch Treatments—Conclusion—Sketch Problems—References.

CHAPTER XII. HOUSE FURNISHING..... 218

Arrangement of Furniture—Pictures—Miscellaneous Articles—Flowers—Furniture—Hangings—Floor Coverings—Conclusion—Sketch Problems—References.

CHAPTER XIII. APPLIANCES..... 229

Power—House Electric Plants—Acetylene Gas Plant—Water Supply—Hot Water Supply—Vacuum Cleaners—Incinerators—Refrigerator Plants—House Telephones—Dumb Elevators or Lifts—Laundry Machines—Miscellaneous Devices—Sketch Problems—References.

CHAPTER XIV. HEATING AND VENTILATION..... 240

Introduction—Fireplaces—Furnace Heating—Steam Heating—Hot Water Heating—Importance of Heating and Ventilation—Sketch Problems—References.

CHAPTER XV. LIGHTING..... 251

Light—Daylight—Artificial Light—Gas—Electricity—Personal Hazard—Electric Wiring—Switches—Circuit Breakers, Cut-outs and Fuses—Lamps—Method of Calculation—Methods of Illumination and Fixtures—Sketch Problems—References.

TABLE OF CONTENTS

	PAGE
CHAPTER XVI. PLUMBING.....	267
Introduction—Water Supply—Drainage—Sewers—Septic Tanks—Fixtures—Sketch Problems—References.	
CHAPTER XVII. GARDENS AND GROUNDS.	277
Introduction — Intimacy — Character — Local Materials—Utilities—Games—Children's Pastimes—Ornamental Architectural Features—Water in the Garden—Rock Gardens—Japanese Gardens—Lawns—Trees—Shrubs—Flowers—Sketch Problems—References.	
CHAPTER XVIII. GARDEN DESIGN AND CONSTRUCTION.....	295
Introduction — Survey — Topographical Drawings—Garden Design — Grading — Planting — Trees—Shrubs and Hardy Vines—Flowers—Conclusion—Sketch Problems—References.	
CHAPTER XIX. THE ENGLISH IDEA OF SMALL HOUSES.....	310
Introduction—Arrangements of Middle Class Cottages—Appliances and Built-in Features—Building Materials—Appearance—Sketch Problems—References.	
CHAPTER XX. PRACTICE OF ARCHITECTURE.....	319
The Profession—Owner, Architect and Contractor—Sketch Problems—References.	
CHAPTER XXI. COST OF DWELLINGS.....	332
Methods of Estimating—Controlling Factors—Economical Points of Buildings—Cost of Masonry—Cost of Framing and Exterior Wood Finish—Cost of Interior Finish—Fixtures and Special Details—Addendum—Sketch Problems—References.	

TABLE OF CONTENTS

PART II.—A PRACTICAL GUIDE FOR HOUSE DESIGN

	PAGE
DRAFTING ROOM MANUAL.....	343
Instruments—Kinds of Drawings—Conventional	
Indications—Architectural Terms—Dimensions	
—Equipment for Rooms	
PROBLEMS IN DESIGN.....	352
GLOSSARY OF ARCHITECTURAL TERMS...	359
INDEX.....	367

DOMESTIC ARCHITECTURE

PART ONE—A TEXT-BOOK

CHAPTER I. HISTORY OF DOMESTIC ARCHITECTURE

SHELTER.—In the beginning man realized that it was necessary to provide for himself a comfortable protection against hostile forces. To accomplish this he used of necessity the materials at hand so that we may assume that hunters and fishermen lived in caves, that tillers of the soil lived in huts of turf or stone and that shepherds and nomads lived in tents. At all times the need of shelter has been the incentive for the construction of dwelling places. The main factors determining the nature of these structures are climate, geology, geography, society, industry and even religion and politics. (See Plate I.)

The Æsthetic Sense.—Races of men arrived at the primitive stage of civilization at widely separated periods of time, or having arrived at about the same time some races failed to make progress. With all peoples it is apparent that the æsthetic sense was early developed. Having made clay articles to be used in their domestic life they became dissatisfied with the plainness of them and took it upon themselves to decorate the surfaces with crude paintings. Also, having made rude dwelling places they set about ornamenting the walls, posts, and lintels with carving, sculpture and paintings. From these early attempts in art, decorative details were ever after closely associated with constructive principles and together they formed the art of architecture.

DOMESTIC ARCHITECTURE

Prehistoric Structures.—Remains of very early structures, not all of which are dwellings, have been discovered in many parts of the world. They are classified as monoliths, dolmens, cromlechs, tumuli, and lake dwellings. Monoliths, or single upright stones, probably erected as monuments, have been found in Brittany. The one at Carnac is 63 feet high, 14 feet in diameter and weighs 260 tons. Dolmens are large tables of stone supported by upright stones and may have been either monuments or shelters. Examples have been found in England, Ireland, and northern France, also in Italy and India. Cromlechs consist of a series of upright stones set in the form of a circle supporting a line of horizontal slabs. These structures may have been temples as the one at Stonehenge suggests. Tumuli are burial mounds and are probably the prototypes of the beehive huts found especially in Wales, Cornwall, and Ireland. The pyramids of Egypt are similar structures in many respects. (See Plates 2 and 3.)

Egyptian Dwellings.—Probably as early as 25,000 B. C. there was a civilization in Egypt and the population was housed in mud huts on the banks of the river Nile. In 4,000 B. C. a date of authenticity, the people were living in houses of unburnt brick, plaster, squared timbers, and stone. The customs of the Egyptians changed most slowly, and although no remains of dwellings of an early date have been discovered it is assumed from later types and from ancient drawings and paintings that the average

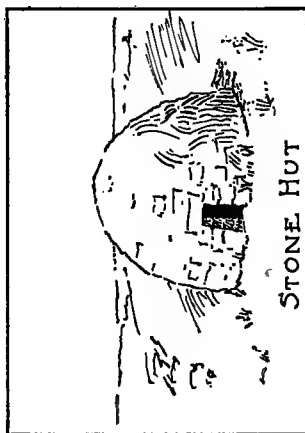
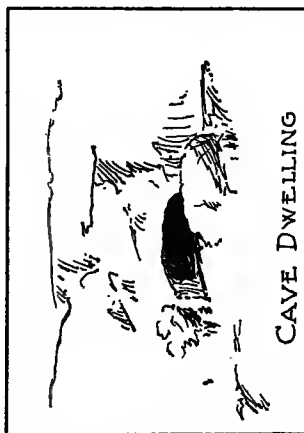
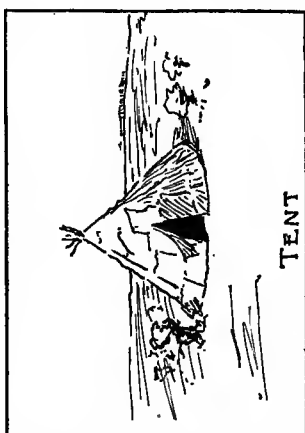
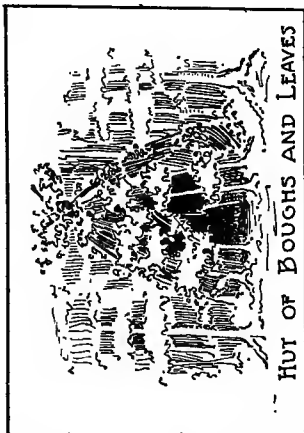


Plate I
PRIMITIVE DWELLINGS

DOMESTIC ARCHITECTURE

rural house consisted of a hall, with a sleeping room on each side, a stairway and a flat roof with a balcony on the stairway to it. Each house had a walled court in front which was really a part of the dwelling for here were the store rooms, oven, poultry houses and the garden. The object of the walled court was to protect the entire establishment from the scorching wind and sand of the desert. These dwellings were invariably placed on the banks of rivers or canals and each was equipped with a pump operated by mules or slaves for supplying water to the household. Gardens were irrigated and made to produce a quantity of fruit and vegetables.

Thus we may assume that each family lived within its walls on a narrow street that followed the water course. The cooking was done by means of the oven built in the open and the meals were served perhaps in the shade of palm trees. The sleeping rooms were much like vaults and afforded protection in all kinds of weather. Very small openings provided light and air from the outside. The balcony and roof were used much as is a modern roof garden, for here awnings were stretched to protect the members of the household from wind and sun. Of the occupation of these people who lived within their walls we know but little. Perhaps they were potters and builders except at the time of year when it was necessary for them to tend the rice fields along the Nile. Perhaps again they were all servants of the king and were compelled to do according to the system of labor that then prevailed. (See Plate 4.)

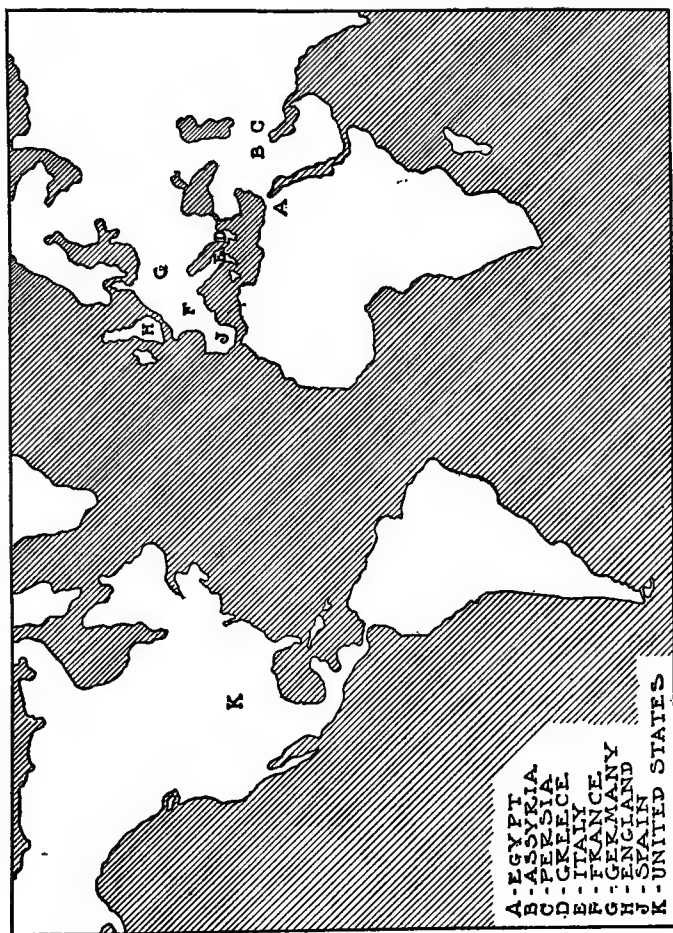


Plate 2

MAP SHOWING WESTWARD PROGRESSION OF CIVILIZATION AND
DEVELOPMENT OF ARCHITECTURE

DOMESTIC ARCHITECTURE

There are several interesting suppositions relative to the origin of the form of Egyptian structures. The walls of all buildings were very substantially inclined and the roof in its projection beyond the wall formed a peculiar curve. Also the cap of columns resembled an inverted bell corresponding in form to the shape of the eaves just mentioned. One of these suppositions is that the primitive structure, which was probably a dwelling, was composed of bundles of reeds stood on end to form walls, being held together by a mass of wet clay. To give solidity to the structure, the bundles of reeds were sloped inward. The roof also consisted of reeds and wet clay the weight of which caused the tops of the upright bundles to bend outward forming the cove in the eaves. This form once established became fixed in the mind of the builders so that later structures although built of different materials had the same form. Another supposition to explain the character and especially the inclined walls of Egyptian buildings is that on account of earthquakes a royal decree forbade the use of any other construction. Probably there is truth in both of these suppositions. At any rate the character of Egyptian architecture is very distinctive. Some houses were two or three stories high and were decorated in colors of which yellow and blue seemed to predominate. Definite forms of ornament gradually developed such as the conventionalized lotus plant, palm, and papyrus. Geometric patterns were also developed.

The palace of a monarch was far more pre-

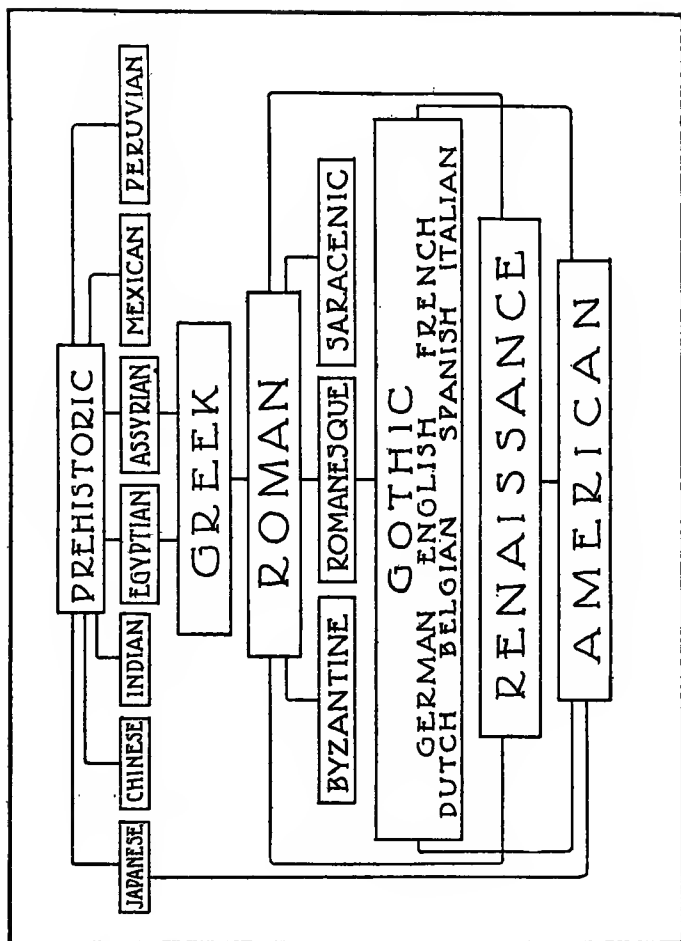


Plate 3

DIAGRAM SHOWING DEVELOPMENT OF ARCHITECTURE FROM THE
PREHISTORIC TO THE AMERICAN

DOMESTIC ARCHITECTURE

tentious than that of the most wealthy subject. It consisted of courts, porticoes, public and private entrances, general chambers, storehouses, and stables. In fact, it was a very complete and beautifully decorated building.

Western Asiatic Domestic Architecture.—The architecture of this part of the world may be divided into three periods: The Babylonian, 4,000 to 1,290 B. C.; the Assyrian, 1290 to 538 B. C.; the Persian, 538 to 333 B. C. During this entire length of time vast changes in the dwellings of the people took place. This race of people was for the most part nomadic, and lived in tents or temporary structures.

The Assyrian period is known as the palace building epoch. Excavations of the palace of Sargon at Khorsabad, built about 700 B. C., reveal a wonderful set of structures covering about twenty-five acres of ground. As is the case with all Assyrian palaces, it is elevated above the plain on a stone and brick platform, being reached by means of stairs and inclines. This platform is forty-six feet high. The palace is divided into three distinct groups: the first includes the palace proper, the men's apartments and reception rooms for visitors; the second includes the harem and private apartments of the prince and his family; the third includes an immense courtyard and service chambers. The main entrance leads into the courtyard and is highly impressive. It is ornamented with ten gigantic human-headed bulls. The main rooms of the palace are treated with colored plaster and a frieze of decorative brick work.

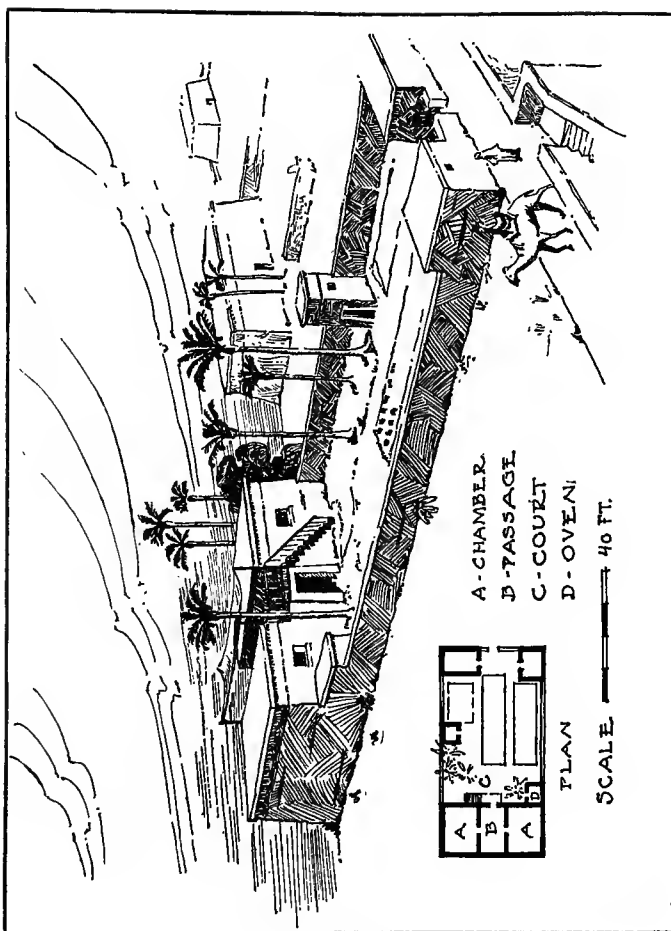


Plate 4
 PREHISTORIC EGYPTIAN DWELLING

DOMESTIC ARCHITECTURE

Greek Domestic Architecture.—The architecture of the Greeks was the pure classic from which most modern architecture developed. The main buildings from which our classic forms are derived were the temples. In recent years palaces have been discovered and unearthed by archeologists showing elaborate structures of an early date, perhaps 3,000 B. C. Prior to this time there must have been an advanced civilization in Greece. A vast array of circumstances makes it impossible to classify the styles and periods of dwellings with any degree of accuracy. The general plan of palaces and less pretentious dwellings as well was about the same, the difference being in size, quality and elaborateness. From the street a doorway opened into an outer court, from which a passage reached an inner court, called a cella. Both courts were open to the sky, and were surrounded by porticoes. Chambers were grouped on all sides, sometimes in two stories, but usually in one.

Roman Domestic Architecture.—Roman houses were modelled from the Greek, as was their entire civilization. Dwellings were of four types: the palace, the villa or country house, the domus or private house, and the insula or apartment house. This last was a common building of several stories constructed in compact blocks, and used much as a modern tenement house.

The palaces of Rome were developed from the simple house of Augustus, 26 B. C., to elaborate structures, 300 A. D., including temples, courts,

gardens, baths, peristyles, passages and chambers covering acres of ground. These were decorated with costly marbles, metals and mosaics, and were adorned with plaster reliefs and frescoes. The most elaborate, probably, was the palace of Diocletian at Spalata. This was laid out like a Roman camp, and covered nearly ten acres. Thus we see that the aggressive, conquering spirit of the Romans at the time of the Roman Empire was reflected in their dwellings.

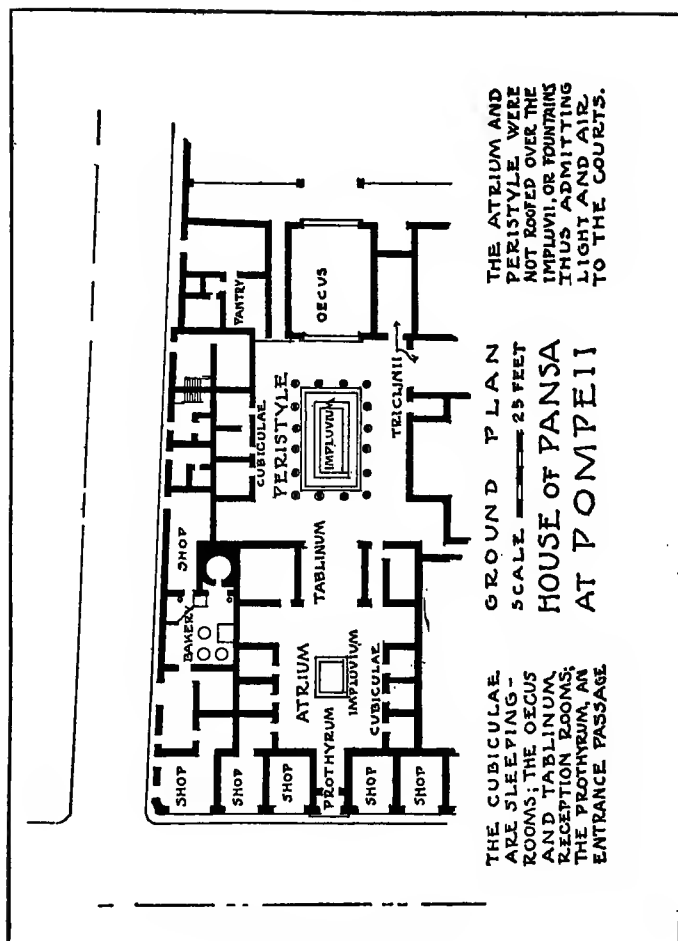
Villas were laid out according to exposure to the sun, prevailing winds and view. They contained baths, theatres and temples, besides the regular chambers built around peristyles for the use of the household. Sometimes there were as many as three or four interior courts containing beautiful fountains and seats. Landscape gardening was developed to a high state, and the villa grounds were magnificently treated. The most famous and extensive villa was that of Hadrian. Its ruins cover hundreds of acres.

There are not many examples of the domus or typical private house to be found. Excavations in Pompeii show that the house usually contained two courts, one of which had the portico surrounding it, and was therefore a peristyle. The entrance was called the Atrium. The part of the house facing the street was converted into shops or was left a solid wall: in fact, all the rooms of the dwelling opened only from the courts, and received light and air from this source, which, on account of the bright climate of Italy, was sufficient. The family lived in the

DOMESTIC ARCHITECTURE

peristyle the greater part of the time, and it was made very livable and beautiful indeed. The walls were either veneered with marble or painted in brilliant colors and fantastic designs. The buildings were very flimsily constructed, which accounts for the fact that only a few examples of the private house remain. (See Plate 5.)

Early European Domestic Architecture.—Out of the chaos of the dark ages in Europe came several distinct types of dwellings, and a confusion of other types. At all times we have had the palace of the strong and the hovel of the weak. From 476 A. D., the time of the fall of the Western Empire, the Church was the main factor of culture. Throughout Europe an architecture called Romanesque was slowly being developed into the Gothic. The buildings were ecclesiastical for the most part, but the influence extended to domestic structures. In France some wonderful palaces were erected. In Germany, the castles on the Rhine and at Nuremberg, Heidelberg and elsewhere are notable examples of early European domestic architecture. During the middle ages, especially in England, fortified castles of the nobles sprang up conforming to conditions, then existing, of many feudal lords with their vassals fighting for supremacy. In the relation of lord and vassal, the former was entitled to service and the latter to protection and maintenance. The castle was a combined residence and military post. The first of these structures were military rather than domestic, and consisted of an outer court, an inner court, and a donjon or keep several



THE CUBICULAE ARE SLEEPING-ROOMS; THE OECUS AND TABLINUM, RECEPTION ROOMS; THE PROTHYRUM, AN ENTRANCE PASSAGE

GROUND PLAN
SCALE — 25 FEET
HOUSE OF PANSA
AT POMPEII

THE ATRIUM AND PERISTYLE WERE NOT ROOFED OVER THE IMPLUVIUM, OR FOUNTAINS THUS ADMITTING LIGHT AND AIR TO THE COURTS.

Plate 5
EARLY ROMAN HOUSE

stories high. All was surrounded by high stone walls with towers and a deep moat with a draw-bridge. Usually the castle was built on a high rocky point, difficult of approach. One of the earlier fortifications is Kenilworth Castle, built in the twelfth century. (See Plate 6.)

These castles were enlarged by adding buildings around the donjon, the great hall above the keep remaining the principal feature. An interesting and typical example of a nobleman's house of the fourteenth century is Panshurst Place, in Kent. The great hall is sixty-eight feet long, thirty-eight feet wide, and forty-eight feet high. At one end there is a raised platform called a dais, and at the other a screen in front of a passage leading to the court, and to the pantry and buttery. The walls were decorated with trophies of the chase, tapestries, and old arms. The floor was covered with rushes.

In a gallery over the entrance at the end of the passage, the minstrels were seated. An open fire was built in the centre of the great hall, the smoke escaping through louvres in the roof, and meats were roasted in vast quantities. The noble and his intimates dined on the raised platform, while the retainers sat about the fire. Servants carried the foodstuffs from the pantry and buttery behind the paneled screen to the diners in the great hall. Dogs and other pet animals ran at large among the members of this establishment. At the close of the night meal, the great hall became the sleeping quarters of the retainers.

Gradually more improvements and additions

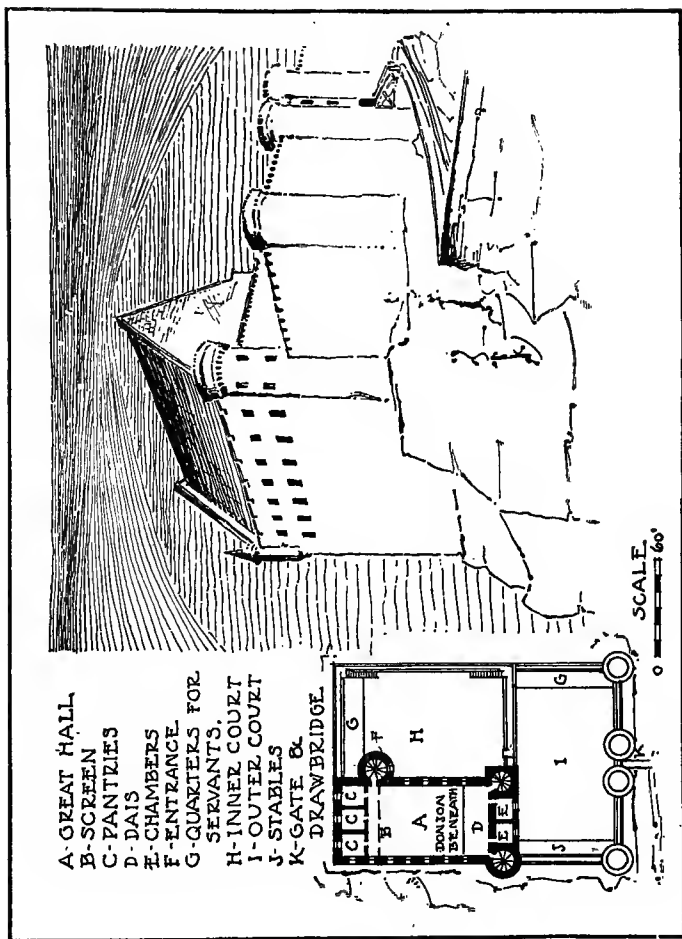
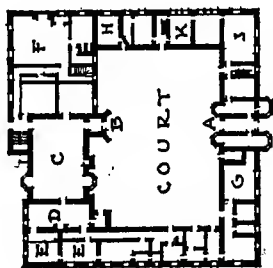


Plate 6
EARLY FEUDAL CASTLE

DOMESTIC ARCHITECTURE

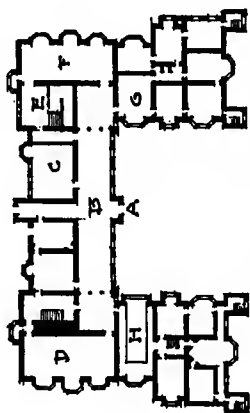
were made to these castles. Wings were annexed to the building to serve as dormitories for the servants. A solar or withdrawing room was added, leaving the great hall for dining purposes only. Towers, chapels, wine cellars, breweries, chambers and extensive service rooms were built on one at a time. The open fire on dogs was abolished, and a hooded niche against the wall was used in its place; this developed into a fireplace with a brick chimney. Eventually, in the sixteenth century, the Tudor house consisted of buildings grouped about a central quadrangular court with a prominent entrance in the centre of one side under a gatehouse, and the hall on the opposite side with other rooms down the ends of the court. Later private dining rooms were introduced, and the modern English house or country home was in a fair way of being logically established. (See Plate 7.)

The origin of towns in France, Germany, Belgium and England was due to the fact that traders and others grouped themselves around the castles of the nobles, or formed dependencies to the monasteries. Afterwards, on account of this movement, there arose in many towns two rival authorities, one the outgrowth of the church, and the other the outgrowth of the establishment of the feudal lord. Towns as well as castles were sometimes fortified, owing to the lawless times. Rothenburg, Germany, is a fascinating example of a small walled city. Finally royal power suppressed petty warfare, and castles to a great extent were done away with. Moreover, in 1500 A. D. gunpowder was



OXBURGH HALL
15TH CENTURY

- A-ENTRANCE GATEWAY
- B-PORCH
- C-HALL
- D-DINING ROOM
- E-WITHDRAWING ROOMS
- F-KITCHEN
- G-LAUNDRY
- H-SERVANTS' HALL
- J-LIBRARY
- K-BREAKFAST ROOM



FIRST FLOOR PLAN
HATFIELD HOUSE
17TH CENTURY

- A-ENTRANCE
- B-GALLERY
- C-HALL
- D-LIBRARY
- E-GRAND STAIRCASE
- F-KING JAMES' ROOM
- G-BILLIARD ROOM
- H-CHAPEL

DOMESTIC ARCHITECTURE

invented, and attacks were made not with brands of fire, spears and swords, but with guns and cannon so that stone walls were no longer sufficient fortification. Thus the homes of the people became domestic in character, rather than military.

Town dwellings often consisted of a shop on the ground floor and sleeping apartments above. The kitchen and service rooms were usually behind the shop on the first floor. In each locality throughout Europe, conditions, materials at hand, climate, individuality and accident brought about many temporary domestic styles, but the variations are not as marked as might be expected. In the higher development of Gothic domestic architecture, relative to castle building, there is a rather marked difference between the structures of the various countries and districts. This is due to national individualism, for which the upper classes or castle builders were responsible. (See Plate 8.)

Renaissance Architecture.—In spite of the growing individualism of Gothic Architecture, the great wave of the Renaissance, or classic revival of architecture, swept over all alike and shattered the original beauty of medieval dwellings. All new parts and additions to castles were made according to the Roman classic style, with variations, so that in the end a building was a conglomerate mass, each part, perhaps, beautiful in itself, but not conforming with other parts. A noted example of this is the Chateau de Blois, which was built by Louis XII and Francis I, between 1498 and 1547 A. D.

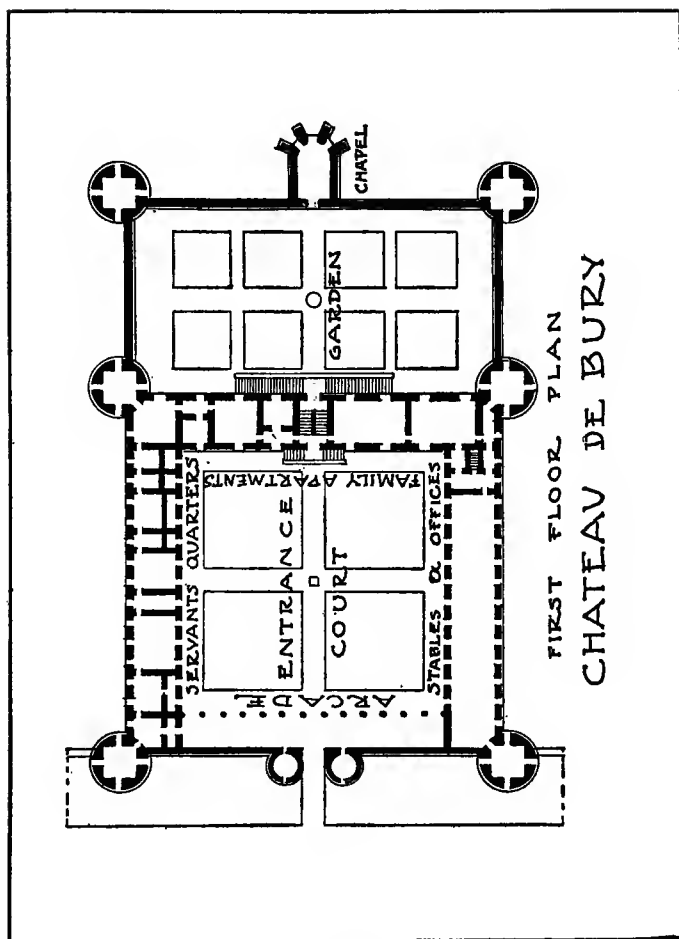


Plate 8
FRENCH CHATEAU

DOMESTIC ARCHITECTURE

All good examples of Renaissance domestic architecture in Europe are of the elaborate type of palace or chateau, such as the Chateau de Blois, built before the style began to degenerate. The Louvre was commenced in 1540 A. D., and not completed until 1857. Meanwhile the style had started on its decline and again been revived. In England the classic influence made itself felt greatly through the Elizabethan and Jacobean periods, until at last, in the Georgian period, the prevailing style was strictly classic. The seventeenth century development was due largely to two architects, Inigo Jones and Sir Christopher Wren. Throughout the Victorian period both Greek architecture and Gothic were revived. Perhaps at the present time the domestic architecture of England may be said to be English Gothic, and is quite a true outgrowth of medieval dwellings.

Conclusion.—Thus through the ages is the history of man chronicled in his architecture, and his private life revealed in the ruins of his dwellings. His first great desire was for a home; his second, for a monument; his third, for a shrine; and his fourth, for a place in which to pursue his occupation.

Oldest science, noblest art:—
A roof for man from beast apart;—
A monument, a shrine, a mart:
Our art of architecture.

Colossal heaps of hewn stone
At cost of centuries' blood and bone;—
The Pharoahs built for whim alone
The pyramids of Egypt.

HISTORY OF DOMESTIC ARCHITECTURE

Of purest line and classic mould,
The conquerors in that nation bold
Erected to the gods of old,
The temples of the Greeks.

Mad with lust of life and power,
An Empire raged through its brief hour,
But left an architectural flower;—
The glory of the Romans.

Through fitful medieval fires
A Gothic race shows its desires
In noble arch and lofty spires;—
Cathedrals of the Christians.

A castle for the strong and wild:
A villa for the calm and mild:
A cottage for the poor man's child:
The homes of all God's people.

Oldest science, noblest art:
A roof for man from beast apart:—
A monument, a shrine, a mart:
Our art of architecture.

SKETCH PROBLEMS

NOTE: For all drawings use a soft pencil and rough white drawing paper 8½"x11", or notebook size. Observe drawings in the text and suggest ideas similarly. Notes on drawings should be lettering rather than script. Whenever possible, drawings should be made free-hand but straight edges, instruments and scales may be used when necessary.

- (1) Make a sketch of a cave dwelling.
- (2) Copy the picture of an Egyptian house.
- (3) Draw from memory a typical feudal castle.

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Thompson.—The History of the Dwelling House.
Nash.—The Mansions of England in the Olden Time.

CHAPTER II. DOMESTIC ARCHITECTURE IN THE UNITED STATES

DWELLINGS of **Pioneers.**—At all times pioneers have been compelled to build their homes of materials at hand. The first settlers in New England, and other places along the Atlantic Coast, erected log cabins and stone huts for temporary shelter and protection. In many instances these houses were also fortifications against hostile Indians. As the country to the west was gradually settled, the same condition of affairs is evidenced. In some states, such as Kansas, where neither building stones nor logs were available, dugouts and houses of turf were used by the people. However, the dwellings of pioneers are erected with the idea of using them for a short time only, and have no bearing upon the development of domestic architecture. Such houses are interesting only from the standpoint of the resourcefulness of determined men and women.

Georgian, or Colonial Architecture.—During the Georgian period of England, the colonies in America assumed an importance of their own. The architecture of the mother country was imitated and our colonial style established. Thus because the colonies were in process of early development at a time when the classic revival of architecture was at its height in Europe, our own architecture was permanently affected, and classic lines and mouldings given to our early homes. So anxious were the colonists to have in their new homes what they had used in the

mother country, that parts of houses, such as mantel pieces, cupboards and doors were brought over in ships and incorporated bodily in the new dwellings.

Colonial Architecture in New England.—The first colonial houses were built from 1600 to 1700. Architecturally they were very plain and simple, with the exception of the Old Stone House at Guilford, which is irregular and picturesque. The plans were rectangular, and consisted of a hallway with rooms on either side, and openings placed symmetrically. The roof was of the gambrel type, and the attic story overhung the story below. Dormers were usually placed in the roof at regular intervals. (See Plate 9.)

The Old Stone House at Guilford, Connecticut, was a residence, a fortification and a meeting-house combined. It was erected by the Reverend Henry Whitfield, in 1634, and is the oldest house in New England. This house was kept in its original form until 1868, when it was remodeled. It consisted of two stories and an attic. In the attic were several recesses, probably intended for places of concealment. All walls were made of stone, and were about three feet thick, so as to withstand a severe attack. This stone was evidently obtained from a quarry about eighty rods from the building site, and was transported at great cost in time and labor. The partitions, which were movable, could be folded back to allow a large space for the gathering of worshipers. The woodwork of the building was of oak.

Another example of the military homes is the

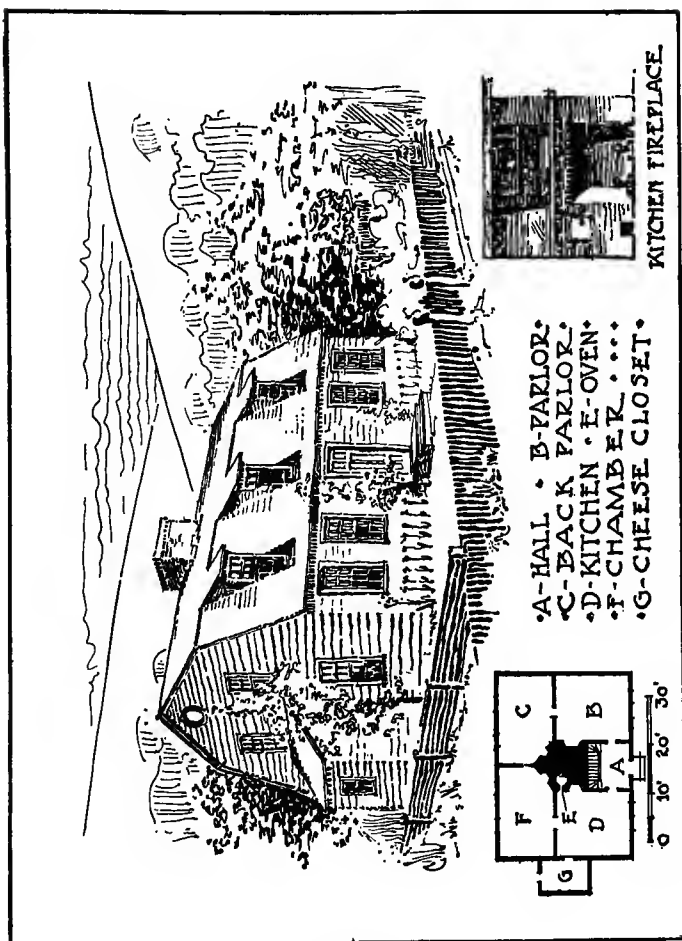


Plate 9
 EARLY NEW ENGLAND FARM HOUSE

DOMESTIC ARCHITECTURE

Red Horse Inn, at Sudbury, Massachusetts, built in 1680, and made famous by Longfellow's "Tales of a Wayside Inn." The Cradock house is also very interesting. The bricks for this building were burned on the site, and the timber used in it was hewn from the surrounding forest. This house was a trading post and a home. A number of loopholes were built into the wall from which to fire rifles, and the doorway was guarded with irons, so that the building has a very military aspect. At each end of the structure a large chimney rises to a considerable height. There is no ornament upon the house except a belt course at the second floor level.

At an early date a cottage type was developed by extending the roof of the building in a long sweep over a one-story part, usually in the rear. Later a low roof was extended in the front as well. The main feature of the cottage was the classical doorway, which was quite typical of all colonial houses. The Witch House in Salem, the home of Paul Revere in Boston, and the home of John Quincy Adams, are examples of this type.

About 1730 prosperity and peace settled upon the colonists. The more prosperous merchants and landowners set about building permanent homes, the log cabin being always in disfavor with these pioneers. Governor Cradock's military home seems to have been a model from which many other houses were evolved. At first the gambrel roof was the common type, but eventually the mansard roof, the ridge roof and the flat roof were developed from it. Most of the plans of the early colonial houses were sym-

metrical. The entrance remained the important feature, and was seldom neglected in the working out of details. It usually consisted of pilasters, cornice and pediment or hood of simpler type. These entrances showed marked individuality in design, and are worthy of extensive study. The interiors of the 1730 homes were very interesting, and often handsome, the stairways and fireplaces being especially important.

The Hancock house in Boston was begun in 1737. It was a stone building, so well constructed that when torn down it was necessary to blast the stones apart. The Hancock house was erected on a hill overlooking the bay, just outside of the city. The entrance was in the centre of the front, which was fifty-six feet wide, and was protected by a balcony above, which opened from the hallway of the second story. On each side of the entrance were two large windows on both the lower and upper floors. The cornice was refined, and altogether the house was a well designed and dignified building.

The Vassal-Craigie-Longfellow house at Cambridge, Massachusetts, was built in 1759, and was the home of Henry Wadsworth Longfellow after 1837. This house was among the first to be designed with a deck on the roof surrounded by a balustrade. It is symmetrical in plan, and has a low porch at each end. The exterior is treated with pilasters, which extend from the ground line to the cornice. In the centre portion two pilasters are planted at the corners of a slight projection which terminates in a pediment in

DOMESTIC ARCHITECTURE

the roof. At each side of this pediment is a dormer window.

Elmwood, at Cambridge, Massachusetts, was built early in the eighteenth century. It was the birthplace and home of James Russell Lowell. Elmwood is three stories high, and stands in a grove of trees planted by the father of the poet. This building is a fine example of the later type of colonial house. A balustrade extends on all sides of the roof immediately over the cornice.

Colonial Architecture in the Middle Colonies.—In New Amsterdam, which later became New York, domestic architecture was influenced from a great many sources. The original colonists were Dutch, but settlers of many nationalities mingled with them. It is said that before the English occupation more than a dozen different languages were spoken in the city of New York, which at that time had less than two thousand inhabitants. Moreover, New York was more liberal and tolerant in regard to religious beliefs than any other colony, so that each man went his way in a more unrestricted manner than would otherwise have been the case. This general spirit is evidenced in the dwellings of the people. The log cabin was necessarily used in the beginning as a shelter and protection, but the Dutch were as intolerant of it as were the New Englanders. Soon houses of stone, brick and frame were erected, influenced again by the classic revival of architecture in Europe. Although the general appearance of these houses was much the same as those in New England, the treatment of parts was more

liberal and ingenious. The gambrel roof was not much in vogue, and when used was greatly modified, the upper slope being reduced so much in size as to be insignificant. The long slope of roof, as used in New England cottages, was often gracefully curved to extend over a lower story. Many of the gable roofs were also curved at the bottom of the slope. Innovations in the way of dormers, entrances, hoods over doorways, and window details were established. Gradually English influence predominated over Dutch, and the colonial style resembled more closely that of the colonies further north. Owing to fires in the city of New York, not many examples of domestic architecture remain. However, in the vicinity of New York, and in other towns along the Hudson, there are a number of old houses still standing, some of which are of historical interest. Among these is the Morris Mansion at 165th street and Ninth avenue, New York City. This building was erected about 1758 by Roger Morris, a British officer, and of course a Tory during the Revolution. Consequently his property was confiscated. Here General Washington made his headquarters during operations near the city. Later the house became the property of Madame Jumel, a French woman who was married to Aaron Burr. This house has slender front porch columns extending to the main cornice, and a balcony at the second floor supported by brackets projecting halfway across the porch floor below. Another house of historical interest is the home of Alexander Hamilton. This house has a small

DOMESTIC ARCHITECTURE

cornice and a balustrade surrounding a flat roof. It had on three sides porches which almost enclosed the building.

Worthy of mention are the Dutch cottages of New York. These had sweeping roofs and interesting windows and porches, varied to quite an extent. The cottage of this style has since developed to a rather prominent type.

In Pennsylvania, especially in Philadelphia and Germantown, there is a wealth of examples of colonial architecture. The first settlers of Pennsylvania were an interesting lot of men. William Penn established upon his immense grant of land a refuge for all religious sects, including the Quakers and Dunkards. The general appearance of the houses of this colony was not greatly different from that of others. Many houses were built of stone, with perhaps a stucco surface, and with brick or stone quoins showing at the corners. The earliest stone houses were very crude. Of these, the home of John Bartram in West Philadelphia, built in 1731, is notable. It has two story, semi-detached columns with Ionic caps. The windows are treated with mouldings cut into the rough stone in imitation of the German classic style of the time. All the stone carving in this building is so crude as to be childish, but it shows the fervor of the builder, and his desire to produce something in a new country which would have the refinement of the old. On Wissahickon Creek there are a large number of old colonial houses, many of which have very interesting details of construction, especially in the interiors.

Colonial Architecture in the South.—Especially in Virginia and South Carolina, a large number of aristocratic Englishmen settled, and later became the original country gentlemen of America. On account of the fertility of the soil and the use of slaves, which were early imported by the Dutch, these men became very wealthy, and because of their natural refinement, they erected houses of taste and durability. Roads in this country were only bridle paths, but the rivers were all-important, since commerce was carried on by means of boats. Thus the homes of the planters were built along the river fronts, especially those of the river James and the Potomac river. Each planter had his own little dock to which the trading vessels from New York and New England would come for the crop of tobacco and other produce. Most of the houses had a front facing the river, and a secondary front facing the plantation of the owner. To this day, along these rivers may be seen the remains of many such houses, which in the early times, and even up to the Civil War, were prosperous establishments. (See Plate 10.)

Since these Southerners were lovers of country life, very few towns came into existence, and still fewer succeeded in becoming permanent cities. Annapolis, in Maryland, was an exception. In this city the streets radiated from two centres, at which were the buildings of the State and the buildings of the Church, the church being the Church of England. The buildings of the city were of the style of the Queen Anne period in England, and included not only res-

DOMESTIC ARCHITECTURE

idences, but churches, schools, clubhouses, a theatre, and a race course. The prosperity of this town lasted only down to the Revolution, when perhaps many of the inhabitants remained loyal to England.

The best houses of the south were of masonry. In the earlier days bricks were imported, but later they were made on the building site. The bond used by bricklayers was usually the Flemish, in many cases the alternating bricks being of a darker color. There is a large variety of plans among the examples of southern colonial architecture. Generally they were symmetrical, consisting of a main unit, with the entrance in the centre of it, and perhaps a wing on each side. On account of the smaller estates having less demand for the accommodation of slaves, servants, and also of guests, the plans of the establishments varied to quite an extent. In Maryland, quarters for the dependents were provided by story and a half wings connected with the main building by means of one-story corridors. In Virginia, these quarters were provided by means of separate structures, sometimes two stories in height, and usually grouped symmetrically.

Among the examples of this style interesting to us are Monticello, the home of Thomas Jefferson, and Mount Vernon, the home of George Washington. Jefferson was a man of diversified capabilities, among his accomplishments being that of architectural design. Monticello, near Charlottesville, Virginia, was erected at the cost of bankruptcy to the owner. It is a

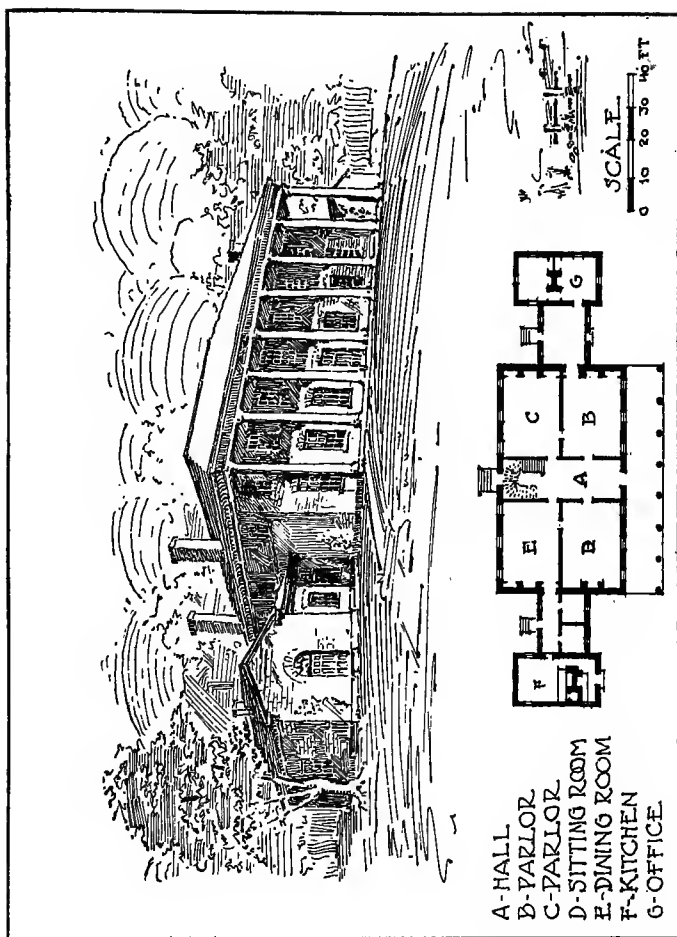


Plate 10
 EARLY SOUTHERN MANSION

DOMESTIC ARCHITECTURE

large symmetrical brick building in which the Italian Renaissance style is imitated. The order of architecture used is Roman Doric.

Mount Vernon is especially interesting to Americans. It is located on the Potomac River with a water front and a garden front. The façade on the water front is treated with a series of square columns, two stories in height, crowned with a classical cornice. The whole building is constructed of wood. The grounds are laid out symmetrically, and have, besides the main building with its two wings, more than a dozen out-buildings, all grouped symmetrically. Here George Washington retired to lead a quiet life after the turmoil of his military and political career.

Spanish Architecture in the South.—Florida was settled between 1500 and 1600 by the Spanish, Juan Ponce de Leon having explored the peninsula in 1513. About the same time many French and English colonists also made their homes upon this coast. The main towns were St. Augustine, Savannah, and Pensacola, which places were first under the control of one European nation, and then of another. However, Spanish influence predominated, so that the buildings were essentially Spanish. The houses were of light colored stone, or of brick with gray, pink, yellow or blue stucco. Most of them were two stories in height, the lower floor, in many cases, being a high basement, while the upper was occupied by the family as living apartments. Many of the windows were treated with wrought iron balconies on brackets. The doorways were

entered from courts. The eaves of the buildings projected, and the roofs were covered with red tile. The type was strictly Spanish, and as the Renaissance affected the architecture of Spain, the colonists made like changes in their dwellings. To this day, the Spanish-American style of architecture is used in Florida, and large hotels and residences with plaster walls and red tile roofs have been erected of late.

Louisiana has a wonderfully interesting history, the heart of Louisiana being the city of New Orleans. Here mingled people of many races, especially French and Spanish. Sections of the city were named according to the nationality of the people living there, and each section was distinguished by its architecture. Many of these old buildings remain standing. Here are courtyards and balconies, doorways and dormer windows of infinite variety. Plastered walls of many colors are now scaled and cracked and covered with moss and vines. Renaissance architecture made its influence felt here as elsewhere, so that the arched doors and windows, iron balconies and wooden eaves were superseded by classic details.

California was first peopled by the Franciscan missionaries, who made their way to San Diego and gradually moved northward, establishing mission houses which stand to the present time. Primarily, these missionaries were educators. At each mission house they established or gathered around them a colony of native Indians whom they taught to cultivate the soil and to raise live stock for their own use and for exporta-

tion. In this way the missions became extremely wealthy for their time, and with cheap labor at hand were enabled to build many houses of rather elaborate plan and type. On account of the climate of Southern California, the tendency was to make the buildings more open than were the prototypes in Spain.

With such interesting historic examples of architecture as an inspiration, the later immigrants to California, of American birth and ancestry, immediately adopted the style of these buildings and have since developed it to an elaborate state. In fact, in many cases the style has been so elaborated as to be unrecognizable. However, the simpler buildings are most beautiful. Many of the bungalows of California at the present time have received their inspiration from the original mission house. A peculiar influence which has acted upon the builders of California is that of Japan. Much of the woodwork, roof lines, and smaller details show distinct Japanese influence. (See Plate 18.)

Late Developments.—The United States of America has been subjected to world-wide influences more than any other country. Its citizens have come from practically every nation. It is no wonder, then, that the architecture of America is conglomerate. We have not only the more original styles which were brought to us by the colonists from many countries, but we have later styles, which have been developed in other countries and brought to us or derived from historic examples. These styles have not been used in their original form, but have been

adapted to our needs. At the present time we can name the style of but a few buildings. We use the terms "Colonial," "Dutch Colonial," "Tudor," "Old English," "Modern English," "Spanish," "French," "Italian," "Mission," "Art Nouveau," and others, but they are rather meaningless, and are gradually going out of use. In the matter of architectural detail the terms are still of some importance.

Our main triumph is in the development of the suburban house, in which we have practically abandoned all precedents. There have been many innovations in the way of conveniences, so that the American house is the most livable in the world. There have also been many innovations in decorative detail, both interior and exterior. A number of architects have distinguished themselves by their ability to create individual mouldings, cornices and like details. Materials at hand, both natural and manufactured, are most numerous and varied. This condition has enabled us to do many things otherwise impossible, but it has also tended to produce inharmonious effects in our buildings in regard to color and to the relation of one part to another.

American houses may be divided into a number of present day types, as the city residence, the country house, the suburban house, the cottage and the bungalow, to say nothing of the apartment house. Each may have any style. By far the most common type in the matter of numbers is the suburban house of rather small proportions which may be either formal or informal. The

DOMESTIC ARCHITECTURE

formal house is symmetrical and prim, while the informal is unsymmetrical and rambling. (See Plates 14 and 15.)

Future Houses.—In the future, American homes will assume a character more national than has yet been achieved, not so much by adapting a historic style to our needs as by building to meet the requirements of everyday life. Increased culture develops the æsthetic sense so that our desire for beautiful architecture will be strengthened. It follows that when better things are wanted by the people, better things will be produced. We may believe that the domestic architecture of the United States will attain an excellence surpassed by none.

SKETCH PROBLEMS

- (1) Make a picture of a pioneer's log cabin.
- (2) Sketch Mt. Vernon, the home of George Washington.
- (3) Draw a typical plan of a New England Colonial house built about 1730. Make drawing at scale of one-eighth of an inch equals one foot.

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CHAPTER III. BUILDING SITES

GENERAL Considerations.—In the selection of a building site, it is well to be guided at first by the æsthetic sense, and later by business sense. Since the site is essentially the location for a home, it is important that it be pleasing. A vision of the thing as it can be is the first requisite, and a business-like working out of the thing as it will be is the second. Familiarity with the district, town or city is much to be desired before choosing a site. It is only after a long acquaintance that close discrimination is possible.

People have a natural tendency to form cliques, bands, circles and societies based upon race, family, means, common interests, personal tastes and occupations. In the selection of a site, it is well to choose the location of the future home where the surroundings will be congenial. Neighbors with progressive tendencies are desirable, such tendencies being evidenced by the appearance of the house and grounds in every respect.

The future of a district is very important. It is difficult to say definitely what strides a community may take, or what development may come to pass. This is a case, then, for judgment, but at all times there is an element of speculation in a real estate transaction. Cost is vital to most prospective buyers. The cost of a property depends upon its popularity, advantages, and many other elements. Property often has a fictitious value brought about sometimes by booms, against which value it is well to guard, since it is not maintained for long.

Public Utilities.—The condition of streets, public roads, private roads and alleys should be investigated, and an authentic map of the district studied. Moreover, such questions as the future upkeep, improvement and grading should be satisfactorily answered. In some cases roads which are generally supposed to be public highways are only private lanes, and do not come under the attention of the city, but must be maintained by the property owners. Pavements, sidewalks, and curbs should be investigated. In many instances these structures have been put in place, but have not yet been paid for, the owners benefited thereby being subjected to periodical assessments for the payment of the same.

Transportation by public vehicles is also an important question. The nearness and routes of the cars and like conveyances will be an important consideration in everyday going and coming. Water, light and heat are, in many cases, supplied by municipal or private plants, so it is well to investigate these in order to be satisfied that the water is pure and constant, and that the light and heat, whether of gas or electricity, are reliable. In some communities a local heating plant supplies steam radiation to all residences. This scheme is a good one, and has been successfully operated in many cases. The capacity and durability of the sewers should also be investigated. Street cleaning and refuse hauling should be taken care of by the city at regular intervals, so as to insure a sanitary condition. Police and fire protection are of importance as well.

Conveniences.—Among the conveniences which may be expected in a suburban district, which are not perhaps utilities, are the church, parks, school, clubs and shopping facilities. The church, if a certain one is preferred, should be within walking distance of the home if possible, since the neighborhood church is often considered to be the ideal church. However, a neighborhood full of churches is not a thing to be desired, since they practically become annoyances to the residents. Parks, if well kept up, are very desirable, especially for children. Much of the property facing suburban parks is for sale only at an extremely high figure, since the owners consider that the park across the way improves the outlook and consequently the value of the property very much. Public schools, and perhaps private schools as well, should be within easy walking distance for the children. The way to the school should not lie through an undesirable part of the city, either on account of unsafe or unsanitary streets or inferior neighborhood. The way to and from school should be the brightest and cleanest possible to attain.

Natural Advantages.—Among the natural advantages may be named exposure to sun and wind, view, both distant and near, shade trees of large size, drainage, sanitary conditions, soils, and opportunities for landscaping. Exposure to sun and wind varies in each case, but in any event it is well to consider the question from every angle. Some people prefer a southern or eastern front, and others prefer a northern or western, so that the whole matter resolves itself

into individual whim. However, each side of the building has its advantages and disadvantages, as well as its especial uses, and no matter whether a house faces east or west, we still have the sun to either benefit or hamper us according to our wisdom in arranging the rooms. In regard to distant view, it has been said that some property sells more for the things that may be seen from it than for its actual worth. This is true to quite an extent, but undoubtedly view is worth something, and sometimes very much indeed.

Old shade trees already upon a property are of great value, and should be preserved in every case. In fact, a shade tree well placed and in good condition may be worth several hundred dollars or may even be of inestimable value because if destroyed could not be replaced. Natural drainage is to be desired, and although practically any tract of land may be drained, a tract from which the water flows naturally is much better, and is invariably a more attractive spot. Swamps or low stretches of land should be avoided. It is better to be entirely out of proximity to them. Flies, mosquitoes, and other insects and pests may usually be traced to a condition of dampness and filth.

Soils, especially on large lots of natural beauty, are exceedingly important. On small lots a surface of good soil may quite easily be artificially placed. Lots whereon refuse matter has been placed, or even old soil hauled and dumped, are not very desirable, because it takes many years for an artificial soil of considerable depth to

DOMESTIC ARCHITECTURE

pack thoroughly hard and settle so as to maintain the foundations of a structure. In such a case, however, the foundations should penetrate to the original soil to secure a bearing. Many things make for a successful ground or garden treatment, but especial attention should be given to the matter of landscaping.

City Lots.—City lots differ from suburban lots in that they are situated in a part of the city long established. The lots usually reach by degrees a maximum worth, depending upon the character, growth, and the popularity of the neighborhood, after which that whole section of the city deteriorates in the thing for which it was once known, and the lots gradually decrease in value until at last they are not salable unless a business district has supplanted a residence district. A number of years usually elapses before this phenomenon is complete. Values of city lots at any given time are determined by the character of the neighborhood and its residents. Usually in the selection of a city lot, the main consideration is social environment, and all other things are made subservient to it. In such neighborhoods, that is, highly respectable neighborhoods, minor considerations or details of everyday service are taken care of scientifically and usually in an artificial manner.

Suburban Lots.—Suburban lots are by far the most common, and may be said to include not only city suburban lots, but building sites in small towns. Cost, of course, is an important consideration, since prices of suburban lots vary from one hundred to ten thousand dollars or

more. This consideration would then, of course, be very important. The common size for a suburban lot is fifty feet by one hundred feet, but in many suburban districts both the streets and the building sites are laid out irregularly, and the lots are apt to be more square in proportion, approximating, perhaps, one hundred by one hundred feet. The general lay of suburban lots is important, but judgment becomes a matter of individual taste, except for the principles of natural advantages, generally accepted. Alleys and private ways from the standpoint of service will be found to be of the greatest importance in actual living experience on the home site. An alley in the rear not only saves the expense of a private service way from the front, but is also more economical from nearly every standpoint. Such an alley becomes the service way for a whole block of houses, and incidentally should be cared for by all who have the benefit of it, as well as by the city.

Of the natural advantages of a suburban lot, perhaps the slope of the ground is the most important. Ordinarily a slope toward the street, with a mild or gradual incline, is best, especially since it eliminates the necessity of artificial grading, terracing or retaining of earth. Lots sloping to one side or the other may be desirable if other natural conditions are right. In all cases it is well to have natural drainage. Lots sloping away from the street are in many cases undesirable. However, with some, unique landscape treatments are possible which will correct the original unlikely lay of the land. When

DOMESTIC ARCHITECTURE

the grade from the street to the location of the future house is slight, a fill of earth may be used to bring about the desired fall of land away from the house to the street. If the slope is great, then perhaps the proper treatment would be to make the main façade of the building toward the rear, that is to say, make a garden front. In all probability the distant outlook from this side of the house would be superior to that of the other sides. Often the most pleasing results in landscaping of small places is obtained from eccentric conditions. (See Plate 47.)

In a comparison between corner lots and inside lots, each has its advantages and disadvantages, perhaps divided equally, but the corner lot usually is held for sale at a higher figure. In the case of the corner lot, a house may be set off as an object for view to a much better advantage than on an inside lot, but home privacy is lost to a great extent. Since a house is not on exhibition, the idea of display is fundamentally wrong. A house should be set off to give it a private appearance rather than a public. To insure privacy on the corner lot, it is usually found necessary to build a screen on the less desirable street side, which may be a wall of masonry, a hedge, a lattice or other feature of landscape gardening. Assessments on a corner lot are higher than on an inside lot.

Most good lots in a suburb have placed upon them certain restrictions relative to buildings. Of these restrictions the common ones are the cost of the building itself, which must exceed a stipulated amount, the character or architec-

tural style of the building, the distance of the building from the street and from the side lot lines as well, the kind of walks and drives to be used, the method of grading, and the exclusion of all buildings except private residences. Although restrictions may appear to a prospective buyer as an interference with his rights, nevertheless temperate restrictions are a distinct advantage to the permanent resident. Restrictions are placed upon a certain "addition" or section of the city for a stated length of time by the property owner or owners. Any subsequent owner within the same length of time must comply with these restrictions under penalty of reversion of title to the former owner.

Sites for Country Places.—In the selection of a tract of land for a country home the natural advantages are all-important. Of course the public highway and the private road should be kept in mind, since the approach of a country place is an important feature. The condition of the public highway and the distance from the site, the character or use of the vicinity, and the future of it are also important. Of the natural advantages the first consideration should be topography; the second, trees and other plants; the third, distant view; the fourth, soil; and the fifth, exposure to elements. Here, above all places, the æsthetic sense should control the choice of a location.

In many localities, acreage or small tracts of land of an acre or more are sold for the purpose of being used as a small farm or ranch or for the purpose of speculation, assuming that at a future

DOMESTIC ARCHITECTURE

time this same tract will be salable as town or suburban lots. Acreage is often sold at a fictitious value, more often perhaps than any other kind of real estate. Acreage, then, is not usually a good investment, but may be if bought at the real value and used for the purpose for which it is best adapted. Therefore the soil, drainage and other points that pertain to agriculture are of the greatest importance.

Farm Sites.—A large number of considerations determine the best location for the house on the farm. Perhaps the highway and the facilities for getting to all parts of the farm at any time are the main determining factors. A farmhouse should be placed upon an elevated part of the ranch or farm, and should preferably be placed in a grove of trees. These two things, however, usually coincide, since knolls are quite often wooded. Moreover, such a knoll is not valuable for the purpose of cultivation. Trees provide not only a background to improve the appearance of the farmhouse, but provide also shelter from the cold winds of winter and the heat of summer. In fact, a good grove moderates all kinds of weather, which is of benefit not only to the family, but to the live stock, which is necessarily housed not a great distance from the farm residence. Outbuildings should be so placed as to have natural drainage, and should be set an appreciable distance from the house, for sanitary reasons. Prevailing winds should blow from the outbuildings away from the house rather than toward it. Circulation or means of hauling and handling of live stock should be fully

provided in the lay-out of a farm place. A convenient means of circulation will save in a few years the cost of all extra roads, fences and gates, and moreover the convenience then established is ready for permanent use. An important item of consideration is the water supply. In many instances it is the first consideration, so that houses have been built in the lowest part of a tract of land simply because a spring of water existed there. Natural advantages and necessities cannot be overestimated. (See Plate 48.)

SKETCH PROBLEMS

(1) Draw a plan of a favorite building site and note on the drawing by means of lettering the reasons for its desirability. Make drawing at the scale of one inch equals ten feet, approximately.

(2) Draw an undesirable building site with which you are familiar and note the reasons for its undesirability.

(3) Make a map showing an ideal arrangement of lots, streets, and alleys for a suburban district. Show size of lots and widths of streets and alleys, also widths of public walks, parkings, pavements, etc. The drawing is to show from four to six blocks at convenient scale and is to have noted upon it such conditions as slope of ground, directions and natural assets.

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CHAPTER IV. HOUSE DESIGN

GENERAL Considerations.—In the design of a particular house perhaps the first consideration is cost, for although a small family may have a house of seven rooms costing twenty thousand dollars, a family of equal size may also have a house of seven rooms costing only two thousand dollars. The latter house may or may not have the same amount of floor area as the former. Thus it is necessary to determine to some extent in the beginning the size and quality of the house in order to arrive at the cost. Such factors as kinds of rough materials, method of construction, finish, fixtures and equipment are the most important. In an ordinary house where the maximum floor area is necessary, quality must be sacrificed and expensive parts omitted to a great extent. In a house where elegance is essential, floor area becomes secondary and equipment and finish important.

Types of Plans.—Usually the exact type of plan to be used is not determined until a building site has been selected, which is highly proper. Lots are of practically every shape, and it is always necessary to adapt the house plan or lay-out of the building to this given shape. Broad lots may readily accommodate the type of plan in which the broad sides of the house face the street in front, and a garden, perhaps, in the rear. Narrow lots necessarily must have a type of plan in which the end of the house faces the street, unless the house is very small indeed. Usually such houses should have the

entrance, not at the extreme front, but halfway down one side, so that the entrance will be more in the centre of the building, and thereby allow more free and economical circulation or means of reaching the various rooms. Large, roomy lots will allow a type of plan of almost any regular or irregular shape, and quite often suggest a rambling plan for the house. The natural conditions of the lot must be taken into consideration in every case before determining the plan or style of the house. Grade, permanent trees, exposure to sun and wind, and all like elements are very important.

Individuality.—Individuality in a house is beyond description. To attain it it is well to plan alone rather than to consult intimates or examine precedents. In this solitary planning, which may extend over a period of years, a large number of elements pertaining to private life enter into the matter. First comes the actual use of the house by the various members of the family, both for the immediate and for the distant future. The habits of each individual who is to occupy the house should receive due consideration, and that individual should be made comfortable and happy by a special arrangement of the things which he is to use almost exclusively. To enumerate some of them, the shape and size of his bedroom, sleeping porch, dressing room and wardrobe, and the proportion and detail of his bookcase, secretary, table, fireplace and window seat are important. By designing a house to meet the exact requirements of the family, individuality will be attained.

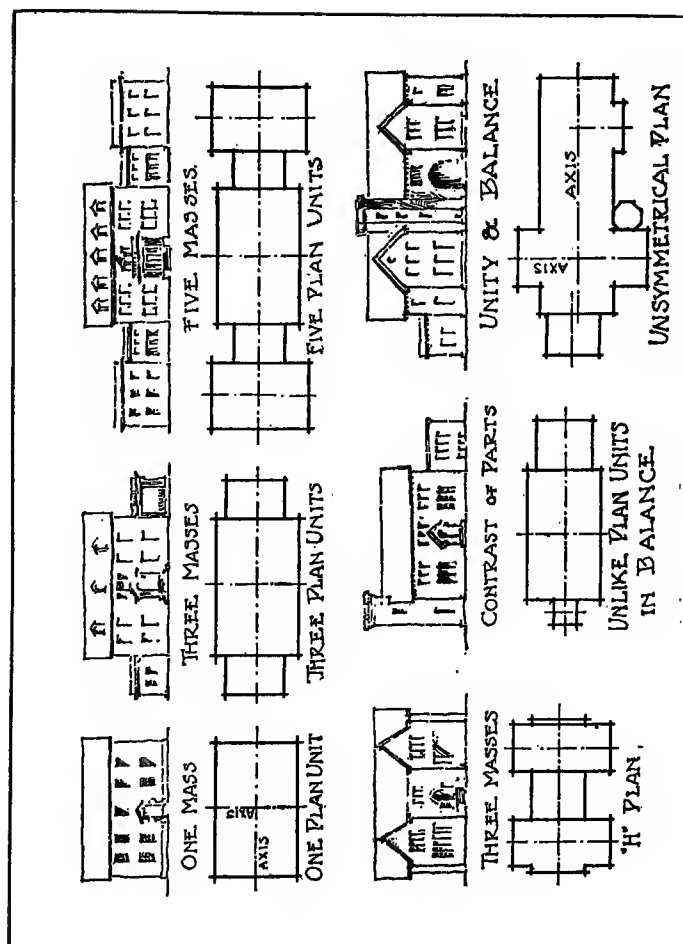


Plate 11
 DIAGRAMS SHOWING ARCHITECTURAL COMPOSITION

DOMESTIC ARCHITECTURE

Other things less tangible than these may be individually expressed. Occasionally the general spirit or feeling of an entire building suggests the personality of the designer.

Character of Exteriors.—The character of building preferred by the owner is of importance in house design. However, a certain preferred character or style of architecture may not always be compatible with the neighboring buildings, or with the lay of the land. In all cases, therefore, it is necessary to study the architectural styles of the immediate vicinity, and also to consider what kind of a building, whether of horizontal or vertical lines, would look best upon the chosen site. The material at hand may determine, to a great extent, this character, since the effective use of any material is limited. The pitch of the roof, the type of cornice or eaves, and the detail of all parts such as the doors, windows, porches, special belt courses and water-tables, and the facing of the building go to make up the appearance of the whole. Each historic style of architecture has forms peculiar to it. Exterior details of construction, chief of which is the main cornice or crowning member of the building, have certain functions and are rarely used simply as ornaments. The function of the cornice is to carry the gutter at the edge of the roof and to form an eaves for the protection of the wall below. Originally the cornice was constructed upon the rafter ends as it is in most cases to-day and was a practical device to meet weather conditions. By embellishment it has become a very beautiful architectural feature.

The exterior of a building should not only be pleasing but should express the spirit of the design. Mount Vernon, on the Potomac, is dear to Americans not only because it was the home of Washington, but because the lines of the building itself express purity.

The Geometry of Plans.—Geometry plays an important part in the planning of buildings. Symmetrical buildings usually assume a given geometrical form, often designated as an H-plan, T-plan, or other combination of forms. The original unit, which is used to make these forms, is the square or the rectangle. A rectangle should be of good proportion in itself, one dimension exceeding the other by perhaps one-half or more, and a square should be a perfect square. Circular forms, hexagons and octagons are also common units. These units are arranged in such a manner as to make an interesting and pleasing combination, in which operation a centre line called an axis or perhaps a number of lines called axes are used, in relation with which these units are placed. Ordinarily the dominant unit is placed first, and others added to it. In the case of unsymmetrical plans, a balance of unlike units is sought. Geometry of plans applies not only to the form of the whole building, but to the form of the individual rooms. (See Plate II.)

Composition.—Architectural composition, like any composition, consists of the arrangement of parts. Although the exterior is commonly used as the means of judging a composition, the geometry of the plan really determines

DOMESTIC ARCHITECTURE

it. Therefore the plans and the elevations should be studied together to produce a good design. The essentials of good composition are unity and balance. By unity is meant the arrangement of parts in such a manner as to produce an harmonious whole. By balance is meant, not necessarily a symmetrical arrangement, but an arrangement whereby the general proportions of the building are pleasing. (See Plate II.)

Many principles of design are involved in architectural composition. These principles are instinctively felt by practically everyone, but the trick of applying them is acquired by but a few. Masses in general composition resemble the geometrical units considered in plans. Where only a few masses are used, one should predominate. Where a great number of masses are used, one, two or three should predominate. Similarity of shapes should recur. This does not mean similarity of sizes, but of forms. The façade of a building may consist of a number of planes, each having a similar proportion but a different size. The principle may be applied not only to masses, but to panels, openings, and other special features. Repetition of the same detail is a means of producing a pleasing effect in design. An example of this may be an arcade, a colonnade, or a series of other openings either perpendicular or horizontal in direction. Any opening of this type is called a bay when speaking architecturally. Horizontal bays should be one, three, five, seven, nine or eleven in number rather than even in number. Contrast of parts

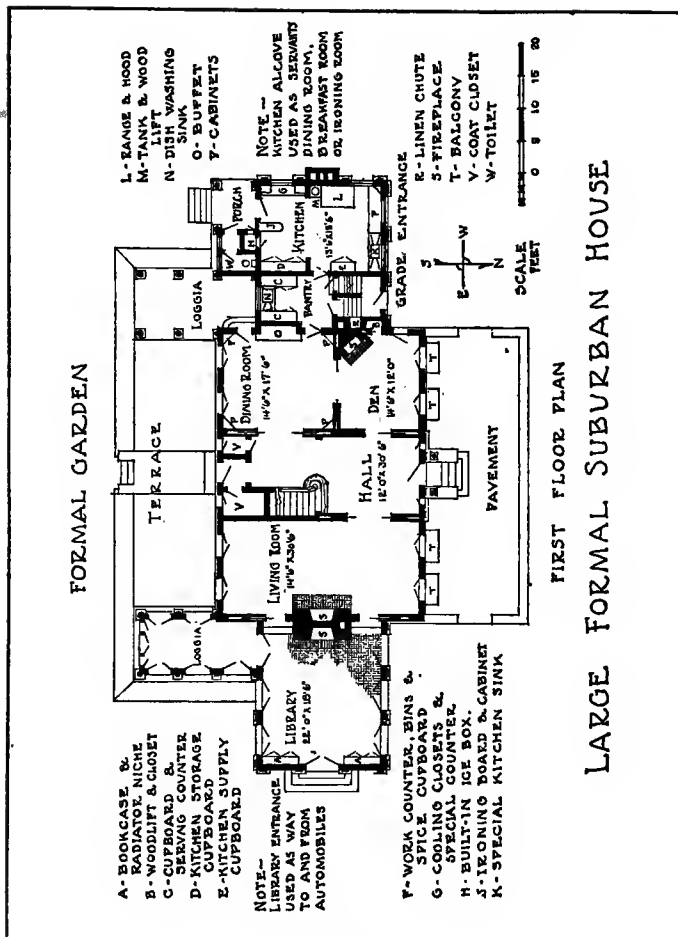


Plate 12

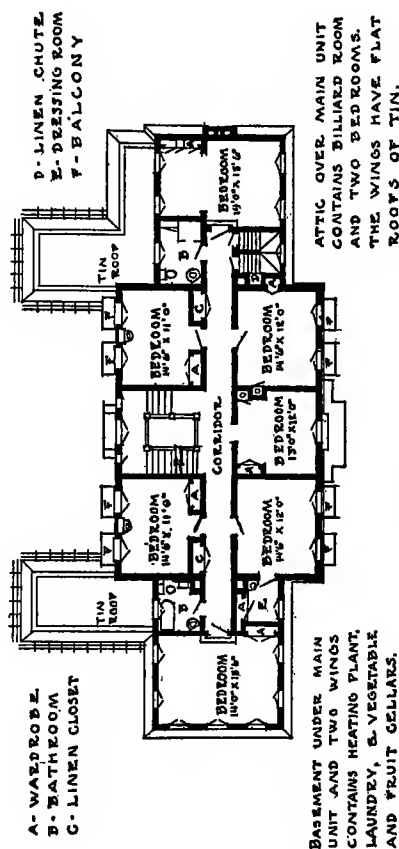
EXAMPLE OF SYMMETRICAL DESIGN—First Floor Plan

DOMESTIC ARCHITECTURE

is an effective means of gaining balance. A slender tower at one extremity of a building may be set up in opposition to a heavy, low mass at the other extremity.

In all designs the exterior should be honest, that is, the units there indicated by groups of windows, bays and gables should mark the location of a compartment within. Ornament, mouldings, and small special details are used to enhance the beauty of the original composition. Scale means the true application of the size of the human figure to architectural composition, with regard to the distance of any part above the ground and the proper relation of parts of the composition to each other. Steps, doorways and balustrades must accommodate people but must also conform to other parts of the structure. A balustrade on the ground may be only one foot high but on top of a high building may be five feet high. In both cases it serves its function and is in scale. The ordinary balustrade is of the proper height to prevent one from falling and to be a convenient hand rail. A ceiling or an arch need be only seven feet high to allow head room but may be many times higher in a monumental structure for the sake of impression.

Arrangement of Rooms.—In the arrangement of rooms, space economy is essential. Perhaps the main consideration in laying out the rooms is to provide free circulation or means of getting from one part of the house to another with the least possible friction and waste of steps. The hall is the chief means of circulation. From it practically all rooms on the first and



SECOND FLOOR PLAN

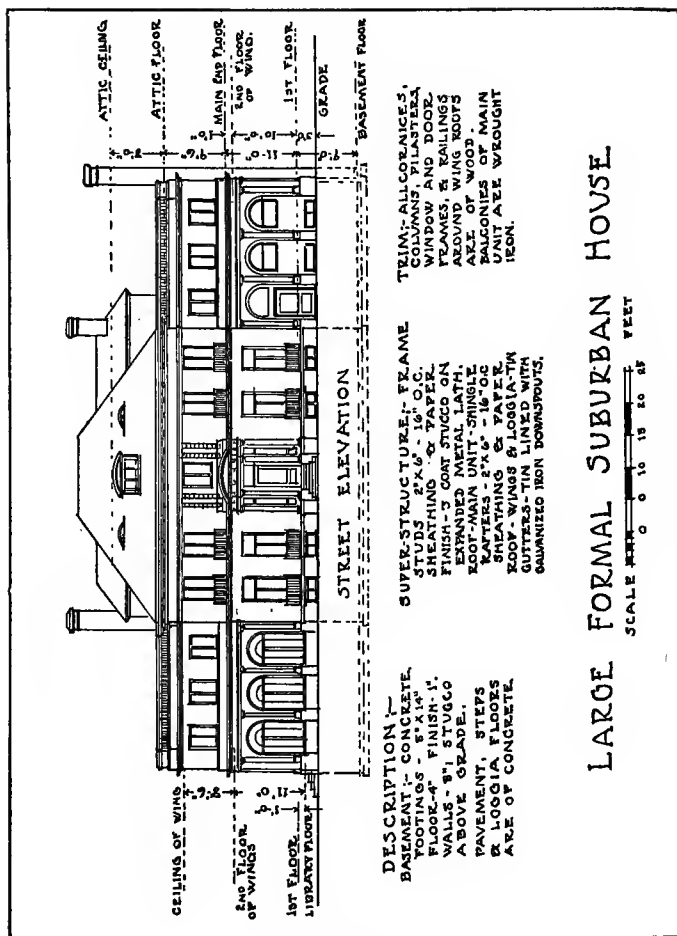
LARGE FORMAL SUBURBAN HOUSE.

DOMESTIC ARCHITECTURE

second floors should be reached. In many instances it is convenient to have both a front and a back hall which should be connected. Stairways should almost invariably be direct from halls rather than from rooms. A very useful feature in houses is the grade door which opens at the grade of the yard or garden onto a landing from which place a stairs leads to the basement and a short flight of steps to the main floor. A grade door should usually be close to the kitchen, thereby allowing one basement stairway in the house to answer all purposes. (See Plate 20.)

Beyond this function of circulation, the hall has little use except sometimes as a means of air circulation and as a place for receiving guests. In regard to the former, care must be taken to prevent all of the warm air of the house from escaping to the upper story. In regard to the latter use, the hall must be made large enough to serve as a reception hall. In pretentious houses it is well to have a reception room in immediate proximity to the hall and main entrance. This room should be, usually, small and formal and of a symmetrical design. In certain types of houses, especially very informal ones, halls are not absolutely essential.

The various parts of a house relative to their actual use should be segregated. These parts ordinarily consist of the living apartments, the sleeping apartments, and the dining and cooking apartments. In many cases other apartments such as rooms for servants or hired help will be found necessary.



LARGE FORMAL SUBURBAN HOUSE

Plate 14

EXAMPLE OF SYMMETRICAL DESIGN—Street Elevation

Living Apartments.—Rooms used in only a few houses and of minor importance are parlors, tea rooms, billiard rooms, and sometimes smoking rooms. A parlor or a tea room should be near the reception room or hall. A billiard or a smoking room should be near the dining room, or isolated completely from other living apartments of the house.

The library in many houses is an important room. Since libraries are used more or less individually, this room may be somewhat isolated, but still within reach from the main entrance in case the occupant is in the habit of receiving callers in that place. Music rooms, dens, offices, art and other museums are somewhat of the nature of libraries, and should be set, perhaps, a little aside from the regular rooms. The main hall may be used as an art gallery, for a few impersonal pieces.

In the ordinary house, the living room takes the place of practically all of the above named rooms, so that it should really combine the uses of them all. If in the house there is no library, a certain portion of the living room should be set aside in a cosy fashion containing bookcases where one may read comfortably. If in the house there is no music room, then an inside wall of the living room should be especially designed and reserved for a piano, and music cabinet. Since the living room is occupied for a large part of the day by the woman of the house, it may be well to fit a particular part of that room with the paraphernalia needed in ordinary sewing work, so that the room also becomes a

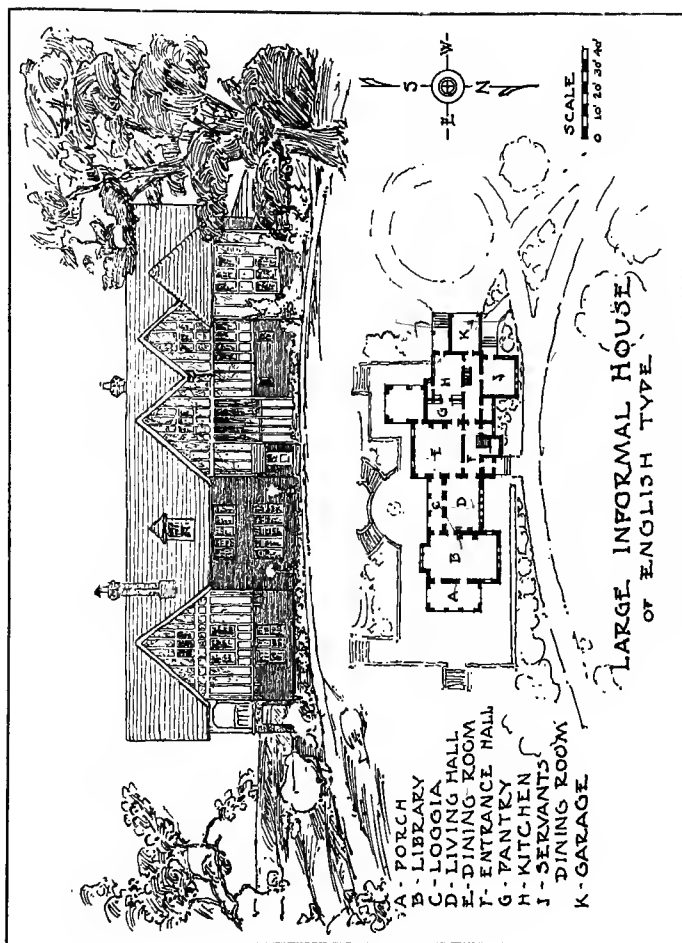


Plate 15
EXAMPLE OF UNSYMMETRICAL DESIGN

sewing room. Sometimes a writing desk, or secretary, is desirable in a living room. In many small houses, the dining room is left out of the design, so that a living room may even become the dining room as well. Thus, the deduction is that a living room should be a room in which to live in every sense of the word, the variations in its arrangement depending upon the other rooms of the house, and the habits of the family. The living room should occupy the most desirable part of the house from the standpoint of exposure to sun and view.

Sleeping Apartments and Accessories.—Bedrooms should, first of all, be so placed as to be well ventilated. To accomplish this end, it is well to have windows on two sides of the room whenever possible. The ceilings should not be too low, nor the top of the windows too far below the ceiling itself. Casement windows or hinged windows are preferable to double hung or sliding windows, since the full capacity of the window opening may, in the first instance, be utilized for air circulation. A bedroom should always have a closet or a built-in wardrobe. In recent years, the sleeping porch has assumed a new importance in all sections of the country, so that the former bedroom becomes more of a dressing room than a sleeping chamber. A sleeping porch is better placed on the second floor than on the first, because the quality of air is better at a distance above the ground. Moreover, an upper sleeping porch is more private and less exposed to odors, insects and other nuisances. A porch of this kind should be open on three sides if

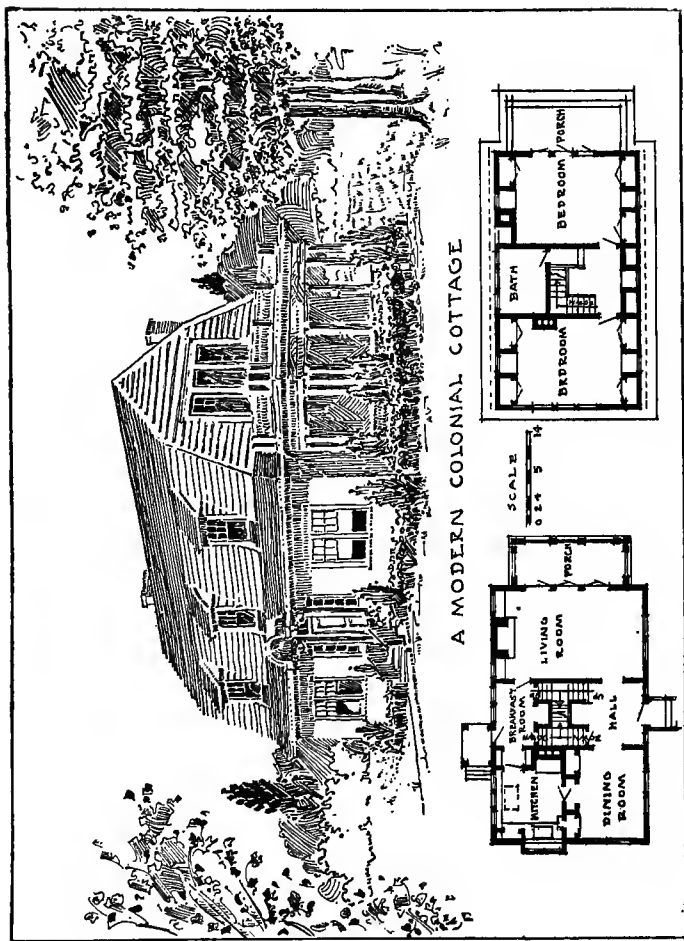


Plate 16
AN ADAPTATION FROM EARLY NEW ENGLAND ARCHITECTURE

DOMESTIC ARCHITECTURE

possible, but should have windows or other screens which may be adjusted to suit the condition of wind, heat and cold. The floor of the sleeping porch may be treated much as the deck of a boat, to avoid leakage of rain water to parts below. A small dressing room in connection with the bedroom proper is a great convenience, and should be in close proximity to the bathroom. A dressing room, to be of the greatest use, should be fully equipped with a built-in wardrobe, dressing table, chair, mirrors and other fixtures used by the particular individual who is to have the room.

A bathroom, when not designed especially for the use of the occupant of a particular bedroom, should be entered from a hall, and the fixtures should be so placed as to avoid nooks and corners, which are difficult of access and consequently hard to keep clean. The bathroom floor and walls should be of waterproof material, as far as possible, tile being the best and of course the most expensive. If the bathtub itself can be built of tile and become a part of the tile construction, the condition is most sanitary and satisfactory. If possible, it is well to provide a floor drain, either in the centre of the floor or by allowing the floor to slope gently in one direction or toward a corner. A bathroom should be provided with a towel closet and medicine case, by all means, and other cases or closets when such fixtures are desired. It is often quite convenient to have the clothes chute in the bathroom wall, since perhaps the most inconvenient handling of soiled clothes is in

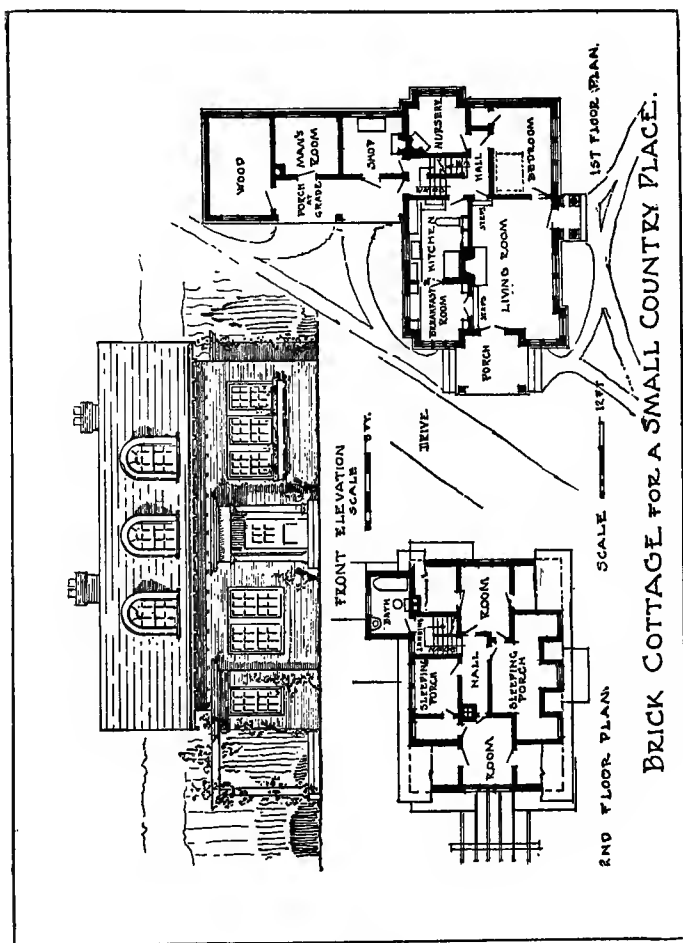


Plate 17
A PRACTICAL DESIGN

connection with this room. The supply of bedroom linen should be kept in a special closet within reach of all the bedrooms, and at a point convenient for bringing it in from the laundry or sorting room. Usually in a two-story house the linen closet is best placed at the head of the rear stairs. Among the accessories of bedrooms are the store room and trunk room, which, like the linen closet, should be in a convenient place, however small, rather than in a remote corner.

A room which can at some time be conveniently used as a nursery and later as a child's room, may very well be incorporated in the sleeping apartments of a house. It should be in a favored, sunny spot, open to the bath and to a sleeping porch, if possible, for the use of the child. It should never be subject to cold drafts from doors or windows. The room may have miniature fittings and decorations to please the fancy of a small boy or girl. It is often worth while to put this room adjacent to a downstairs bedroom.

Dining and Cooking Apartments.—The design of the dining room varies almost as much as that of the thoroughly discussed kitchen. This room is considered by some to be used more at night than in the daytime, consequently its location in the house is important only as a place in which to dine and as a place readily accessible from the living room and from the kitchen and pantry. In all cases the latter consideration is important. This room is considered by others to be very much a room for sunshine, consequently it should have a southerly exposure with large

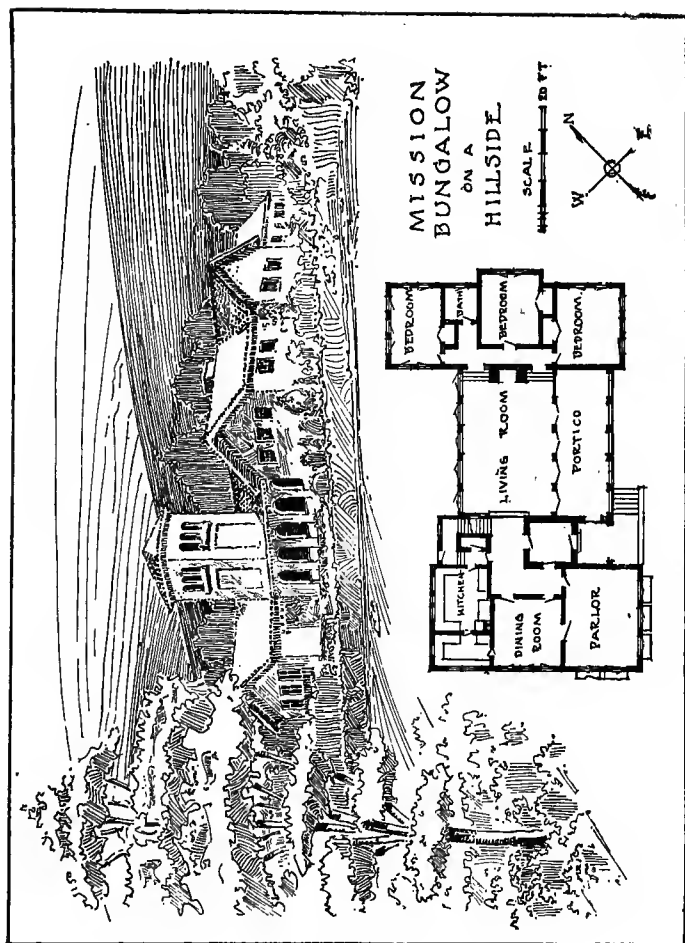


Plate 18
A DEVELOPMENT OF THE SPANISH MISSION

DOMESTIC ARCHITECTURE

windows. In such a case a plant conservatory may very readily be affixed, either of large or small dimensions.

A kitchen is a workshop, and should be designed as such: therefore, such economic considerations as saving of steps and other motions, convenience of equipment and personal comfort of the occupant should receive attention. Sunshine should reach every kitchen, and ventilation or cross draft of fresh air should be provided for. Kitchens may be large or small, depending upon other conditions. A room nineteen feet square for a kitchen in a tiny suburban home would be as grossly out of place as would a room nine feet square for a kitchen in a farmhouse, where the farmer's wife was obliged to serve a large number of hungry men. Nevertheless, each size, one being more than four times as large as the other, is a reasonable size for a kitchen. There is no definite floor area that is proper in every case. A reasonable average size is ten feet by twelve feet.

A kitchen is of such importance as to receive probably the second choice of location in the house, the living room having received first. In the design of a kitchen it is well to remember that the life of a house is from twenty to a hundred years, or more, and that the actual use of a kitchen by the same person may undergo a radical change in a very few years. Causes for such a change might be increase or decrease in fortune, which would perhaps mean the engaging or releasing of servants, increase in family, which necessitates more work, and often change

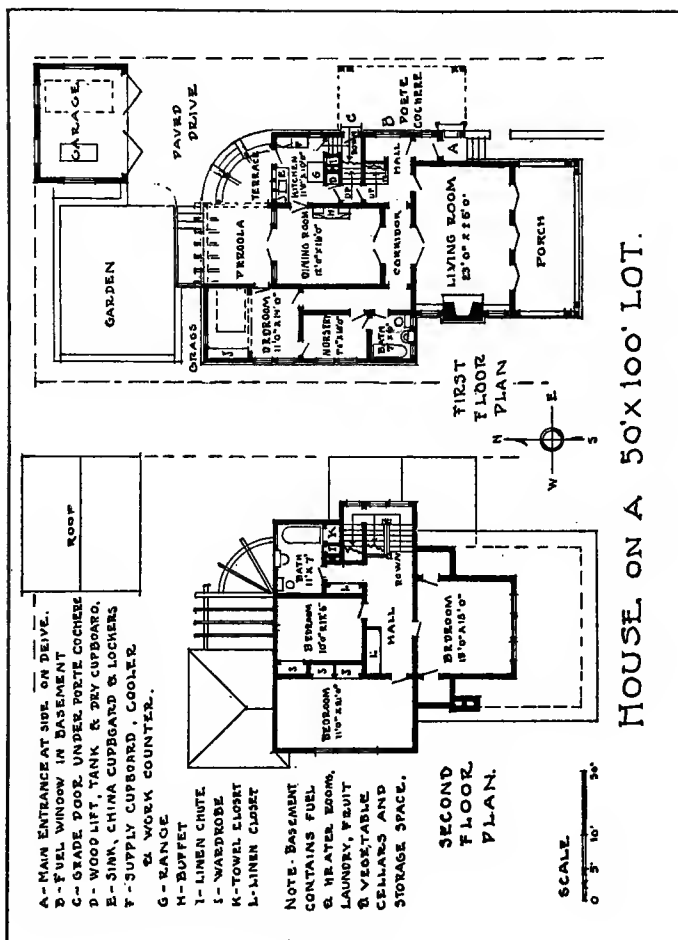
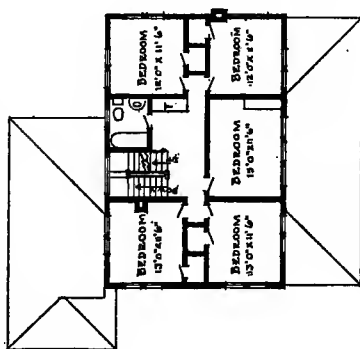


Plate 19
DESIGN EMPHASIZING THE SIDE ENTRANCE

of opinion brought about by scientific investigation or popular notion. Moreover, the absence from home of a number of the inmates of the house may cause a radical change in the domestic routine. Sometimes the absence becomes permanent, and a house designed for many to live in is left for the sole occupation of one or two. The advent of one or more public utilities might change the working scheme of a kitchen. Changing conditions cannot be absolutely counted upon, and preadjusted. Eccentricity of the kitchen plan should be avoided, and the kitchen built along somewhat conventional lines, since the eccentric kitchen may cause a house to be unsalable, as well as unsuitable to other workers.

Kitchen for the Very Small Suburban House.—The kitchen occupied by the housewife for a comparatively short time each day while she performs the light kitchen duties required in a little house may be very small indeed, and usually the smaller the better. In this type of kitchen the economic principles of kitchen design should be applied stringently, so that the range, sink, work table, china cupboard, refrigerator, and service to the dining room should have the proper economic relation. The saving of steps is especially important when the work of the house is done by the housewife herself. Usually a service pantry is not desirable in a small house, a service cupboard opening from both the dining room and kitchen being a great labor-saving device. The sink should be adjoining to the service cupboard counter, so that the dishes having been passed through from the

NOTE, BASEMENT CONTAINS HEATER & FUEL ROOMS,
VEGETABLE ROOM, ROOT CELLAR AND
FRUIT ROOMS.

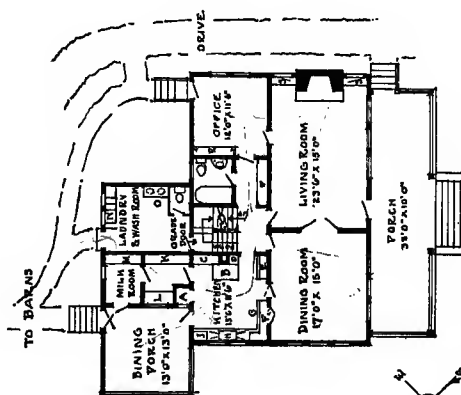


SECOND FLOOR PLAN

A-REFRIGERATOR
B-RANGE
C-DRY CLOSET
D-FUEL & TANK
E-SUPPLY CUPBOARD
F-PASS CUPBOARD

G-WORK COUNTER
H-SINK & BINS
J-COOL CLOSET
K-SHELVES
L-COUNTER
M-SHELVES

N-WASH TUBS
O-WASH BOWLS
P-COAT CLOSET
R-WARDROBE
S-BOOKCASE
T-LINEN CLOSET



FIRST FLOOR PLAN

FARM HOUSE

SCALE
FEET 0 5 10 15 20

dining room may be washed and replaced in the cupboard ready for the next meal with the minimum amount of handling. The drain should be at the left of the sink, with the china cupboard above and facing it, if possible. All of the kitchen equipment should be compactly arranged, with perhaps a small storage pantry in the rear of the room. The way to the cellar, to the yard and to the fuel supply should be as convenient as possible, avoiding an excessive number of steps. (See Plate 16.)

Kitchen for the Large Suburban House.—The household work of a large suburban house would probably be done by one or more servants, with perhaps the housewife's assistance and superintendence. Here more room should be allowed in the kitchen proper, since the cook may occupy this room almost exclusively, while a serving maid or butler occupies the service or butler's pantry at mealtimes. In a kitchen of this type the line of travel between the sink and the range, the supply room and the sink, the work table and the sink, and in fact between all other fixtures used many times each day, should be the shortest distance possible. However, since the room is occupied by a certain individual many hours at a time, it should not be uncomfortably small, which would necessarily cause the room to be hot and stifling. For this kitchen a convenient size is thirteen feet square. In a house of this type the butler's pantry has a distinct use, although the word "pass pantry" is a better designation for it. Between this small room and the kitchen, a service cupboard

[illegible]

A - RANGE
B - SINK
C - CUPBOARD
D - WORK COUNTER
WITH BINS BENEATH
E - PANTRY
F - COAT CLOSET
G - WASH BASIN
H - WARDROBE
J - LINEN CLOSET

A FARM BUNGALOW

SCALE: ~~1"=10'~~ 1"=25 FT.

Plate 21

DESIGN OF HOUSE FOR THE SMALL FARM

may be conveniently used, so that dishes to be served on the table may be set inside of it from the kitchen, and taken to the dining room by the maid. Ordinarily two double-action or swinging doors connecting the pantry with the dining room and with the kitchen are a convenient means of circulation. The pass pantry should have a sink for washing dishes, while the kitchen should have a sink for general purposes. The kitchen should either be amply equipped with storage cupboards, or should have a special storage pantry in the rear, as well as a cool closet or refrigerator, and other necessary equipment. (See Plates 22, 23, 24, 25.)

Kitchen for a Farmhouse.—A kitchen for a farmhouse is more difficult to design than any other kitchen, since it is of more relative importance and use. Although any kitchen is a workshop, this room is the seat of practically all the operations of the housewife of the farm. Not only is a great amount of cooking done, but of necessity the laundry work, butter making, canning of fruit and vegetables, and the thousand other duties of the woman of the house are carried on in the immediate vicinity of the kitchen itself. Consequently the dining and cooking apartments must include a space for cooking, a space for serving, a cool or milk room, a laundry and wash-up room, a passage from the rear to the dining room, a stairway, a screened porch, a fuel room, and sometimes other lesser spaces such as broom closets, and store rooms.

Ordinarily the kitchen should not be too small, on account of the great amount of cooking so

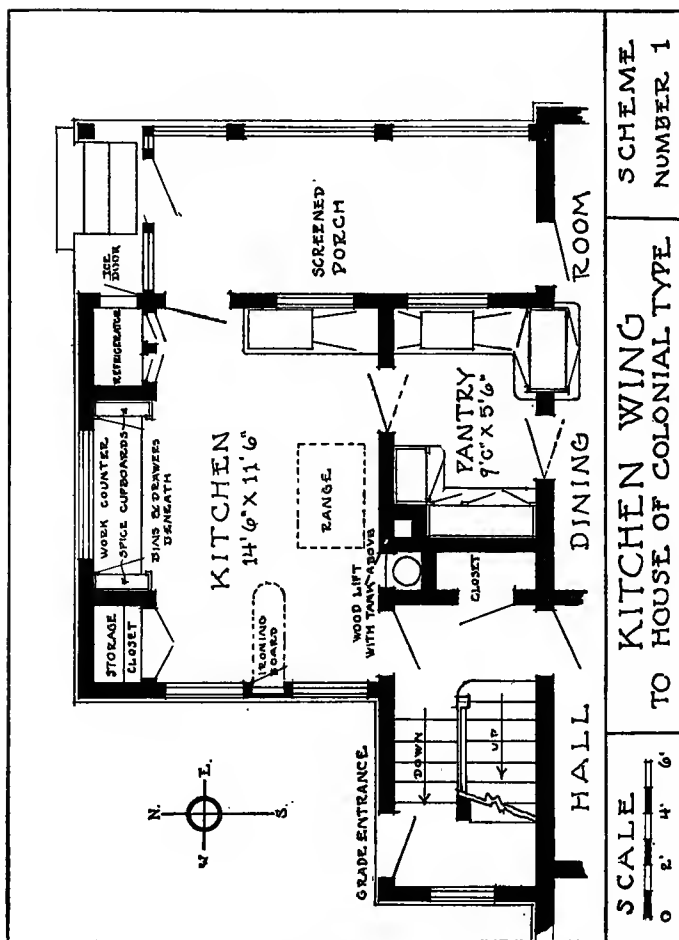
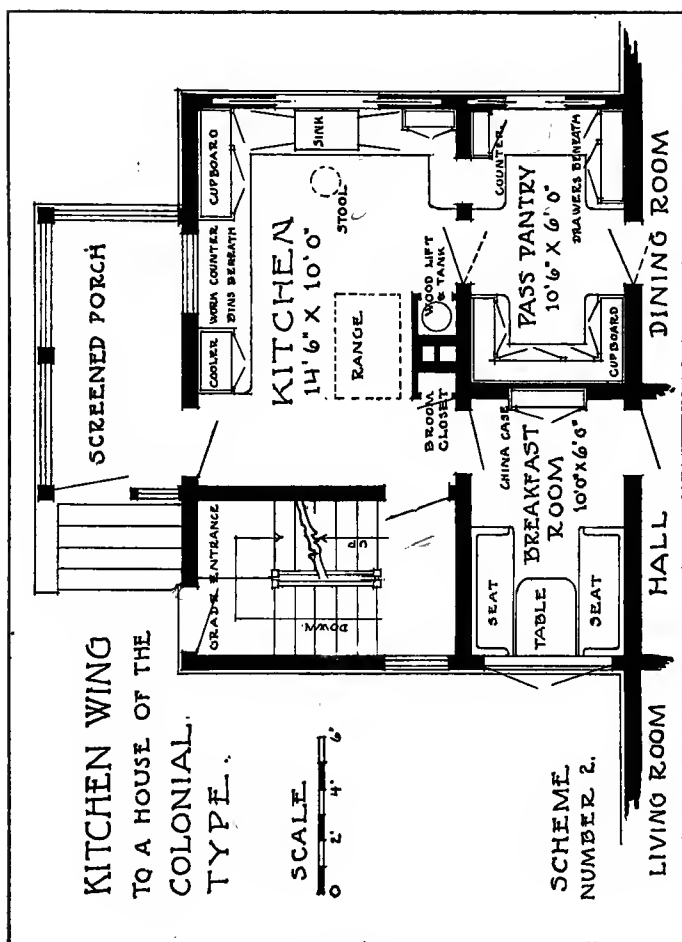


Plate 22
 KITCHEN SOLUTION NO. 1

often necessary. Here, as in all kitchens, the arrangement of fixtures should be economical in order to save steps, but on account of many doors which are necessary to reach the other workrooms, the arrangement of the fixtures is difficult, oftentimes causing the room to be somewhat larger than necessary. However, the kitchen of greater dimensions is more airy than the kitchen of very small dimensions. In the best designs a rear hall is used as a means of getting to the other workrooms rather than many doors in the kitchen itself. A pantry for the storage of food supplies is essential to the farm kitchen, since supplies are usually purchased in quantities, and stored for future use. Here, then, the shelves should extend practically to the ceiling, allowing space below the bottom shelf for setting barrels and large boxes, in which many supplies are shipped. Both store pantries and kitchens are of a better shape square than when long and narrow. The milk room is very important in farmhouses, since the entire establishment must depend upon its own supply of milk and butter. Here should be a miniature milk house as used by a dairy, having preferably a concrete floor and containing perhaps a separator, churn, milk cans and crocks, all conveniently and permanently provided for by special space, shelves, and benches. This little room should be reached not only from the outside, but also from the rear hall or the kitchen. It is better to have the inside entrance not opening directly from the kitchen on account of the heat. The laundry and wash-up room for farm hands may be identi-



—Plate 23
KITCHEN SOLUTION No. 2

cal, if well placed. This room should also have a concrete or waterproof floor, and like the milk room should be reached from both the outside and the inside. Here should be placed, in a stationary manner, laundry tubs, washing machine, and basins. In order to avoid the passage of men through the kitchen while cooking operations are being carried on, it is necessary to have a hall from the wash-up room to the table, and sometimes to the living or waiting room. One rear hall should answer for all purposes.

The relation of the kitchen and dining room in the farmhouse may vary in a number of ways. Originally, one large room, the old-fashioned farm kitchen, was used for both cooking and dining, which perhaps, after all, is not far from the proper way, providing that the adjacent rooms are properly placed. With this arrangement as a basis, a small alcove for cooking purposes has been used which opens directly upon the large room which becomes the dining room. This segregates the men at the table from the women busy serving the meal. Another arrangement is to separate the dining room and the kitchen entirely, as would be done in other houses. It is often well to have a dining porch of considerable size in a farmhouse, thus allowing the dining room proper to be much smaller than would otherwise be possible. Commonly the largest number of farm hands are employed in the summer months when this dining porch could be used almost exclusively. This screened porch may be simply a large kitchen porch used for general purposes, rather than a special dining

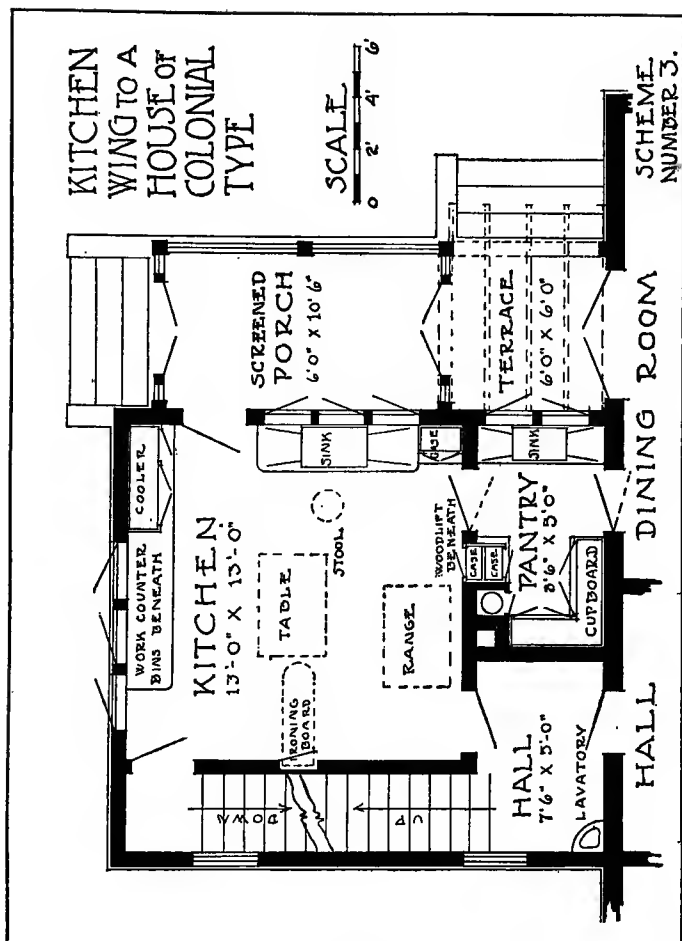


Plate 24
KITCHEN SOLUTION No. 3

porch. The kitchen porch is very important, since much of the preparatory housework may be carried on here during the busiest part of the year. The way to the cellar and also to the second floor should be very near to the kitchen, as is also the case in regard to the fuel supply, since very often each day it is necessary to rebuild the fire. (See Plate 20.)

Rooms for Servants or Hired Help.—In the dwelling of more than ordinary size it is necessary to provide comfortable quarters for servants or for hired help. In the south, these quarters usually consist of special outbuildings. In the west they consist of what is known as the bunk house, but in the east and on the Pacific Coast they usually consist of rooms in the house proper. Rooms for help should be somewhat separated from the other rooms of the house, and reached from perhaps the rear entrance and hall. Where a number of persons are employed, it is well to have a special living room as well as bedrooms, as is done in English houses of some pretension. Rooms for servants should not be poorly arranged and poorly furnished, as is too often the case. Common labor is assuming a greater dignity, and every person is entitled to comfort and consideration.

Porches and Exterior Features.—A porch should not become a part of a building unless it has a distinct use. Porches added to a building for the sole purpose of improving the composition are a failure. If, after a few years a porch floor has not yet had the paint scratched from it, then the porch may as well be removed,

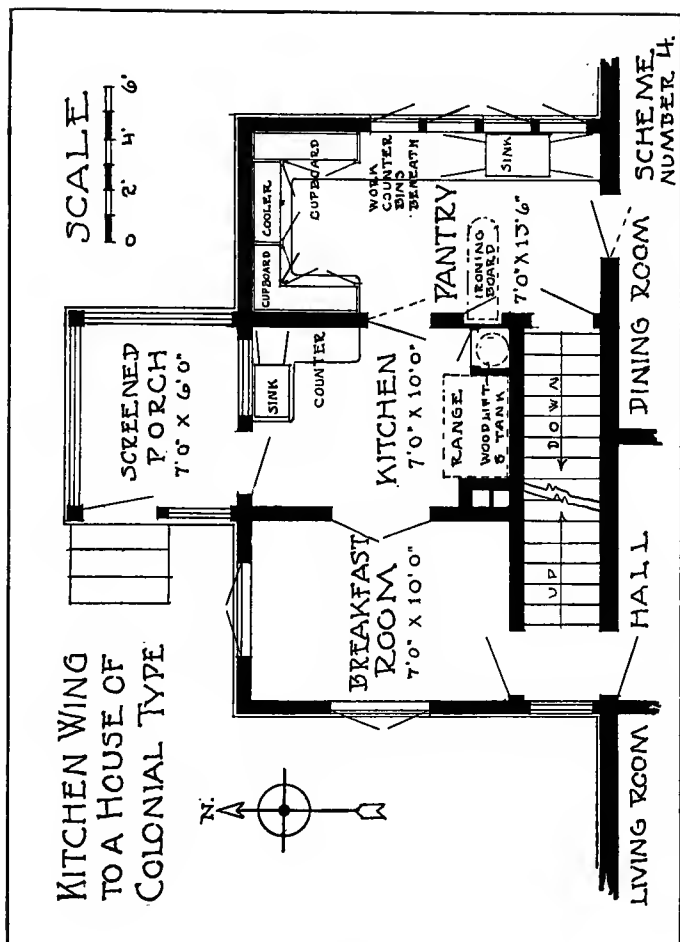


Plate 25
KITCHEN SOLUTION No. 4

DOMESTIC ARCHITECTURE

and something of more importance put in its place. In some climates the porches are almost more important than the rooms, and there may be not only sleeping porches but living and dining porches. The small entrance, stoop or hood, should be distinguished from the porch proper, in that it is not a place for chairs and other furniture, but simply a protection for the door itself made architecturally beautiful, to mark the entrance and to give the doorway the importance which is its due on account of being the source of circulation in the house. A porch used as a sitting porch and also as a passage way to the front door should have the door and steps at one end rather than in the middle. All porches should be attractive and should be designed as a part of the house rather than as an afterthought. In high or two-story houses the porch usually has a cornice of its own, but in low or one-story houses it is almost invariably better to allow the main house roof to cover the porch rather than to give it an independent cornice. The floor of an important porch should be ten or twelve feet wide and may be of wood, tile, brick or concrete.

Porches, as well as the body of the house, may be made attractive by means of flower boxes, trellises and lattices, the success of these things depending very much upon the good taste of the designer, since an infinite number of variations are possible. Among other things that tend to beautify a house and which should really be a part of it, although isolated, are pergolas, arbors, and gates. These should re-

flect the spirit of the house design in form and color. At this point the subject of landscape architecture and gardening meet that of architecture proper. (See Plates 45 and 46.)

Basements.—The basement has a number of uses which should not be neglected, or even put off as a last consideration. Not only is it necessary to provide in the basement special rooms for the heater, fuel, vegetables, and sometimes other supplies, but it is economically necessary to use this space for a number of things which cannot be provided for upon the main floors. By proper lighting, heating and ventilation, a part of the basement may be used as a den, a play room, a shop, a servants' sitting room, or a billiard room. The construction of the house should not be such as to destroy the valuable space in the basement which is acquired with very little expense to the owner of the building. Incidentally, the attic space may be utilized for many purposes, as well as the basement.

Conclusion.—House design is a far-reaching subject, but whether the problem is a cottage or a castle makes little difference in the application of the principles pertaining to it. First of all, the building must be true to the spirit that prompted its erection and beyond that it must be useful, pleasing and substantial.

SKETCH PROBLEMS

(1) Draw the first floor plan of a modern colonial cottage at the scale of $\frac{1}{8}'' = 1' 0''$.

(2) Make two sketch plans, one of a kitchen with which you are familiar and another of the same kitchen remodeled to be most convenient and sanitary. Make sketches at the scale of $\frac{1}{4}'' = 1' 0''$ on two sheets of paper. Letter the drawing.

(3) Sketch the first floor plan of a model farmhouse showing especially the arrangement of the kitchen and rooms used in conjunction with it. Make drawing at the scale of $\frac{1}{8}'' = 1' 0''$.

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Note: For judging a house, by a score card method see Professor John R. Commons' "Dwelling House Score Card."

CHAPTER V. INTERIOR DESIGN AND ARCHITECTURAL FURNITURE

ROOM Design.—In the planning of a particular room, the proportion is important. The same principles apply to it as apply to house design in general. The idea of axes should be applied in laying out openings in the walls and architectural furniture. Usually, groups of windows, important doors, fireplaces, and other large or important features, should be placed on an axis, which in most cases would be in the centre of the wall at the side or end of the room. It is found that in the ordinary residence it is impossible and even undesirable to make all parts symmetrical, but the main objects should occupy central positions. Living rooms, dining rooms, and other important rooms especially should be treated architecturally, and although a number of rooms may open one upon another, giving the appearance of much space, still each unit should have a distinct geometrical plan of its own. For instance, if the front part of a house is to be divided into two parts, one of which is to be used as a living room and the other as a dining room, with a large opening between, it is important to give the living room a distinct rectangular shape, while the dining room might be a perfect square, rather than to make the living room a rectangular shape which was not positive, and to make the dining room only a foot or two greater in one dimension than in the other. Rooms should not be of an L-shape, but in cases where an L-shape is unavoidable, it is well to make the smaller part of the L an

alcove with a beam overhead, separating the two parts. A means of determining the shape of a room is by looking at or imagining the plan of the ceiling, rather than the plan of the floor, since the ceiling plan is never continuous between rooms, while the floor is. Ceiling heights are very important, and should be predetermined according to the use and character of the house. The minimum height is eight feet and the maximum twelve. Although it is often inconvenient to have steps leading from one room to another, such an arrangement of from one to five steps is often very effective: the ceiling height of a smaller room may well be less than the ceiling height of a larger adjoining room. Oftentimes looking from a large living room into an average size dining room, a few steps elevating the floor of the latter, and consequently the dining room suite, gives a very pleasing effect.

Doors and Windows.—The walls of a room are pierced with doors and windows. Doors may be common wood or glass panel hinged doors, double-action doors, heavy sliding doors, single or in pairs, colonial glass doors in pairs, French doors or windows, and doors of special design made of battens or having plain veneered surfaces. Moreover, doors may have transoms and side lights of many shapes and designs. Windows are usually double hung, which are the common sliding windows of two sash, or casement, which are windows hinged at top, side or bottom, to swing out or in. French windows are casements extending to the floor and ar-

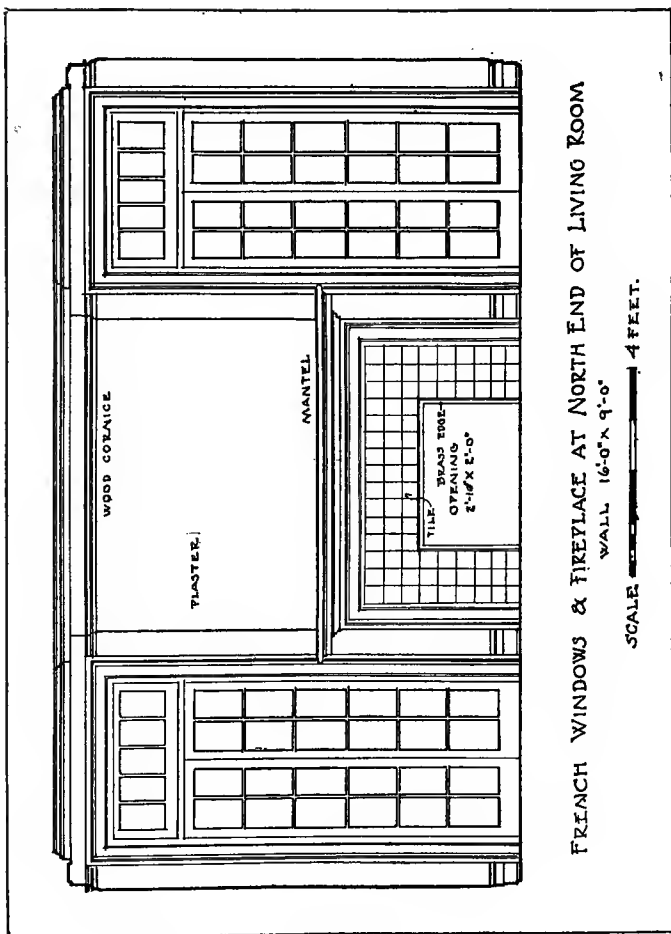


Plate 26
WALL TREATMENT SHOWING COLONIAL INFLUENCE

ranged in pairs. Occasionally windows are hung eccentrically or are set up in a stationary manner. Beyond the sense of utility in placing doors and windows, the treatment of the wall itself should be observed. The same type of window and similar glass panels should be used as far as compatible with convenience. When possible, the heights of all openings in the wall should be the same. A convenient height to use in working out this principle is seven feet, which is a good height for the head jamb of the door, and in low-ceilinged rooms a good height for the head jambs of the windows as well. However, in rooms of more than ordinary ceiling height, it is usually found necessary to make the window head more than seven feet in height in order to get the full benefit of the window as a means of lighting and ventilating the room.¹ In some cases the distance of the head jamb above the finished floor may be eight and one-half feet, while a door with a transom over it may be the same height. If all head jambs cannot be made at the same height, then two heights should be established, with an appreciable difference, so that if the picture mould or other mouldings are carried around the room, they will build into the casings over these openings in a pleasing way, sometimes forming a secondary frieze around the room, as wide as the difference between the two heights. It is never well to pierce the walls of a room with openings without giving thought to the line which these openings

¹ For efficiency in ventilation especially, it is important that the window run up nearly to the ceiling.

INTERIOR DESIGN AND ARCHITECTURAL FURNITURE will make. When no two openings are of the same height, architectural treatment is almost impossible.

Openings in a wall, as indicated on a plan, should be so placed as to give balance. If a fireplace is in the centre of a wall, with a doorway on one side and a window on the other, these two openings should be placed in symmetry one with the other, and although the nature of the openings is not the same, the treatment of them should be similar. When symmetrical arrangement of openings is not possible or desirable, then they should be made to balance by applying other architectural principles of division. It is usually not well to place an opening near the centre of a wall without having it exactly in the centre, and it is not well to crowd a door or a window into the angle or corner of a room. Window openings on the outside wall of the room may be balanced by a door opening on the inside wall; also window openings on the outside wall and on the axis of the room, may be balanced by means of a large fixture opposite, or perhaps only an unbroken wall with a small opening at either extremity. A number of windows in the same wall should usually be grouped together rather than distributed.

Trim.—The interior woodwork of a room, with the exception of fixtures, is called trim, and may be much varied in design and construction. The principal members of interior woodwork, starting at the base of the wall, are the baseboard, with its shoe mould, the chair rail,

DOMESTIC ARCHITECTURE

the picture mould, and the cornice. On each side and at the top of a window opening, the trim is called an architrave or a casing, while at the bottom of the opening, the trim consists of a stool and an apron. Around a doorway the trim is called an architrave or casing, the same as around a window. In many cases there would be a great amount of special trim used in the construction of special details. Wainscotings, panels, beams, stiles, and rails are very common members. Stiles are the vertical members, and rails are the horizontal members that frame panels; thus a door may consist of two stiles and four rails, framing three panels, the two lower of which may be of wood, while the upper may be of glass. (See Plates 26 and 27.)

By using these finishing members in conjunction with the openings in the walls of a room, architectural treatment is brought about. The lines of a room, as suggested before, should be continuous, so that not only the head trim of the openings may be made a line by connecting them with a belt course, but the lower line of windows, formed by the stool and apron, may be made continuous by allowing these two members to run through from window to window, in which case they would become the chair rail. Thus all windows may be tied together, both at the top and at the bottom, but an imaginary line instead of a real belt course might answer as well the purpose of design. The wall space from the stool or inside window sill to the floor may be treated with a wainscoting of any appropriate design. The lower part of the wainscoting would

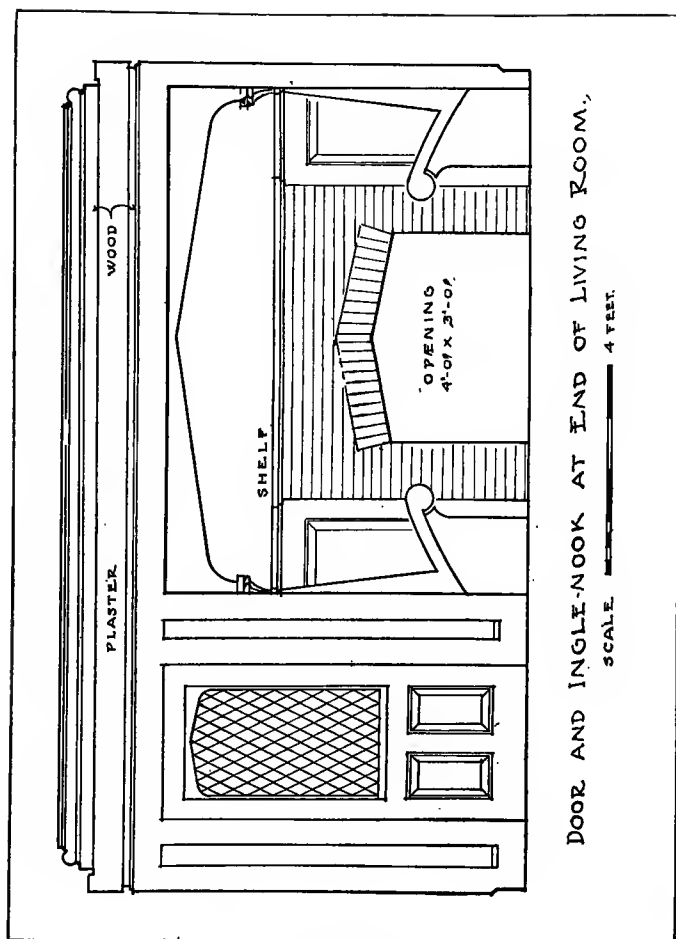


Plate 27
WALL TREATMENT SHOWING ENGLISH GOTHIC INFLUENCE

be the baseboard of the room. Infinite variety of room treatments is possible, so that each room should be designed individually and carefully drafted to insure a pleasing treatment. (See Plates 26, 27, 28, 29.)

Architectural Furniture.—Architectural furniture includes all built-in furniture and cabinet-work. Ordinarily built-in fixtures cost less than portable fixtures but perhaps should not be used so extensively in a house as to give the rooms a fixed ready-made appearance. The amount of architectural furniture to be used in a house depends more upon the general character of the house than upon any other one thing. The personal taste or preference of the owner should really decide the question of amount.

The Living Room.—Probably the most important built-in fixture in the living room is the fireplace and consequently it should occupy the most important position in the room. However, a fireplace should always be out of close proximity to doors since doors not only disturb the serenity of the hearth but also cause uncomfortable drafts. A fireplace in a corner is not very usable and should not be so placed except when necessary. A corner fireplace does save wall space and is sometimes convenient for small rooms and chambers. Fireplaces may be on exterior walls, but are preferable on interior walls. If one is placed on an outside wall, it should probably be on the north in order to save other walls for the admission of light and air through windows. Local conditions determine to a great extent the location of a fireplace.

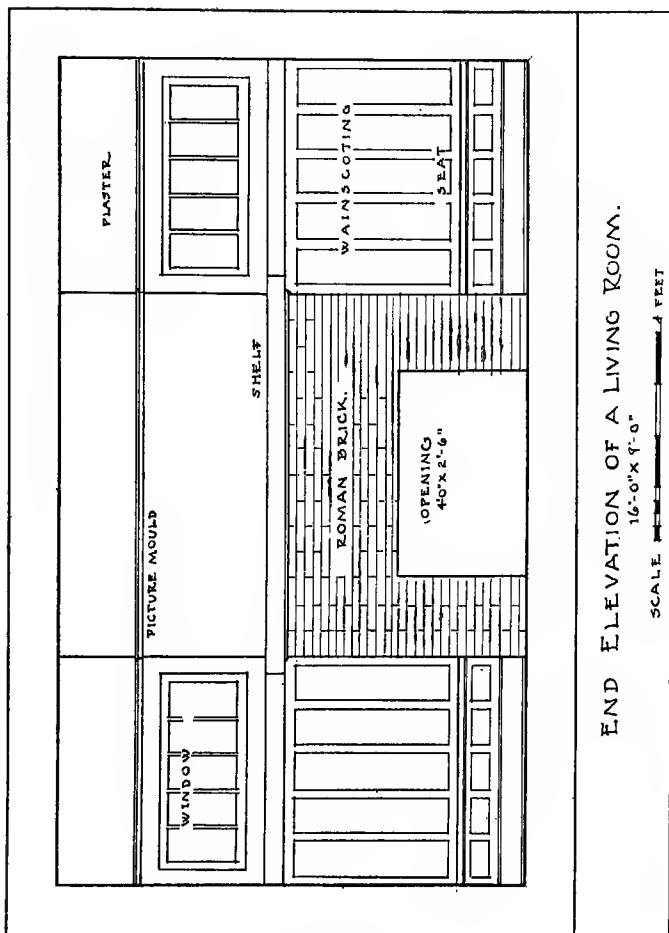


Plate 28
WALL TREATMENT SUITABLE FOR MISSION STYLE

DOMESTIC ARCHITECTURE

In order to insure perfect draft in a fireplace with neither a tendency to draw too hard nor to smoke the room, certain principles of construction must be applied. The depth of the opening should be one-half the width. The height of the opening should be about two feet and six inches, depending somewhat upon the width. The throat or opening into the flue for the escape of smoke should be one-tenth or one-twelfth the area of the front opening of the fireplace. The higher the chimney the smaller the size of the flue may be. House flues are 9" x 9", 9" x 12", 12" x 12" and occasionally 12" x 16". Usually the fireplace flue should be 9" x 12". A draft of air sweeping down the chimney must be diverted from its course into the room by means of a curved floor in the smoke chamber above the throat. Also a draft of air sweeping across the room floor into a fireplace must be conducted through the throat of the chimney rather than allowed to rebound smoke laden into the room. A fireplace is always lined with fireproof materials. In front of the fireplace a hearth must be provided and well supported, and an ash pit constructed below whenever not impossible.

To get the greatest heat from a fireplace the ends should be set diagonally, thereby making the back narrower than the front. This sometimes occasions inconvenience in laying long sticks of wood on the floor or the fire-dogs. Diagonal ends to the fireplace reflect heat into the room as does the back. The back should be perpendicular for about one third of its height in order to bring

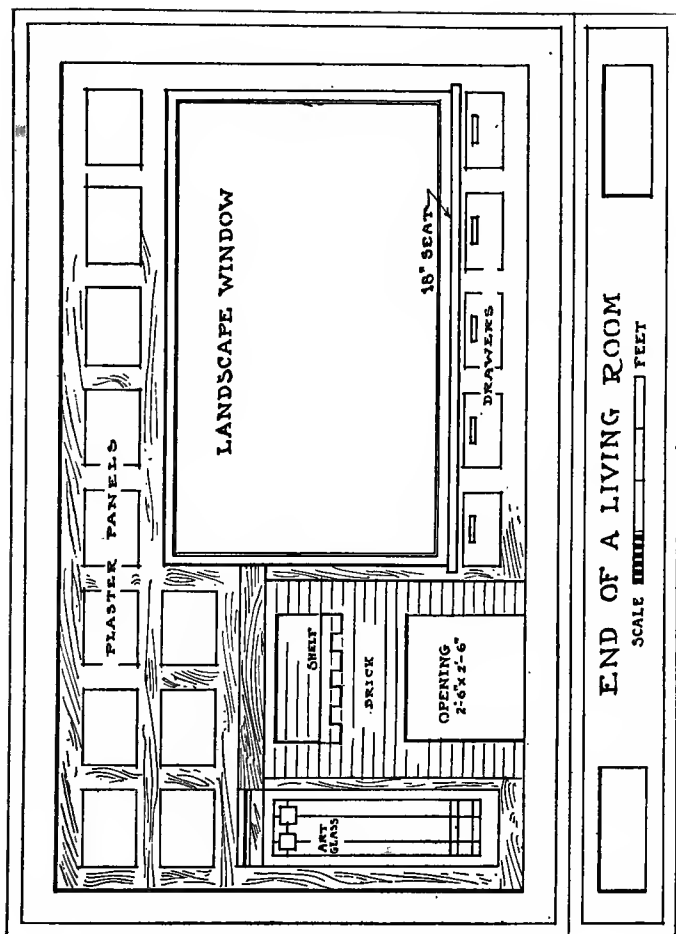


Plate 29
WALL TREATMENT OF ART NOUVEAU DESIGN

about perfect combustion and thereby utilize all of the fuel. (See Plate 30.)

The width of the opening in a fireplace and the design of the whole depends upon the character of the room and the house. However, the fuel to be used regulates to some extent the size of the opening. The purpose for which the mantelpiece is to be used suggests a size and form for it. The difference between a small fireplace in a Colonial house where coal is used for fuel and a large fireplace in a rustic house where cord wood is burned is decidedly marked. For cord wood an opening of four and one-half feet is required.

Bookcases are often built in nearness to the fireplace in order to have a cosy corner. Built-in seats are used in a great number of ways, and may be window seats or fireplace seats. When the fireplace, bookcases and seats are combined, usually an *ingle nook* results, which is simply a small alcove separated from the living room by means of a beam overhead. An *ingle nook* should have a floor,—really the hearth of the fireplace,—made of brick or tile. The ordinary window seat in a house heated by steam or hot water is placed over a radiator, made especially for the purpose. In this case the wood seat is lined with tin and asbestos to protect it and also to throw the heat into the room, the tin having a curved back, thus acting as a heat reflector. Window seats may also be bookcases, magazine cases, wood lifts or storage boxes. Wainscotings and beamed ceilings are used extensively in the treatment of living rooms, and should conform with the architectural furniture. Originally,

beams in a ceiling were used to support the floor above, but now they are of box construction, and are not of structural value. Wainscotings are applied to the plaster similarly to beams, are of thin material, and are usually from one foot to seven feet high. They are useful as a protection to the wall. Billiard tables and piano cases may be made to order to match the other woodwork of the room, and are not usually much more costly than when purchased outright from stock. Special cabinets for collections should not be built in the living room, but may be in a hall or library or other room used less generally. (See Plate 31.)

Bedrooms.—In bedrooms, but more often in dressing rooms, a quantity of architectural furniture may be used. The bed itself may be built in, but usually the built-in bed is a patent contrivance and is installed by the manufacturer. A piece of furniture which takes the place of the bedroom closet is the wardrobe, a cabinet for the keeping of clothes. Such a cabinet should be about eighteen inches in depth, and perhaps four or five feet wide, inside, and should have a pair or more of doors with mirror linings. The doors may be as much as seven feet in height, if they extend to the floor; however, the better way is to have the doors come to within eighteen inches of the floor, with drawers beneath. Upon opening these doors, there should be in immediate reach a low shelf or bench for the keeping of shoes, and a high shelf for the keeping of band boxes and like articles. The distance between the two shelves should be ample for the hanging of suits or gowns on hangers upon an iron pole

DOMESTIC ARCHITECTURE

underneath the hat shelf. The inside of such a wardrobe may well be enameled, so that it will not readily collect dust. Doors should be snug, and of light panel construction,—possibly one and one-eighth inches thick. The design of a built-in wardrobe for the use of a man may vary from that for the use of a woman in the distance between the shoe shelf and the hat shelf, since a dress or gown occupies more space than a man's suit. Sometimes it is desirable to put an additional shelf overhead. The drawers at the base of the wardrobe may be used in a number of ways. It is quite often desirable to have a dressing table with a mirror on one side of the dressing room and a wardrobe with mirror doors on the opposite side. Thereby reflections of great convenience may be arranged. Mirrors may be placed either on the outside or inside of wardrobe doors. When three doors are used, and mirrors placed on the outside, the two end doors are made to hinge from the inside edges, forming a mirrored niche much like the contrivance used by tailors. The little compartments of a dressing table should be arranged according to the taste and actual use of the one who is to occupy the apartment.

Chiffoniers and dressers may be built against or into the walls of bedrooms or dressing rooms, and may be of practically any design. A chiffonier should not be made clumsy in proportion, a common fault being that the depth of the fixture is too great. Linen and towel closets should be designed to hold conveniently the linen articles without a great heaping up of the

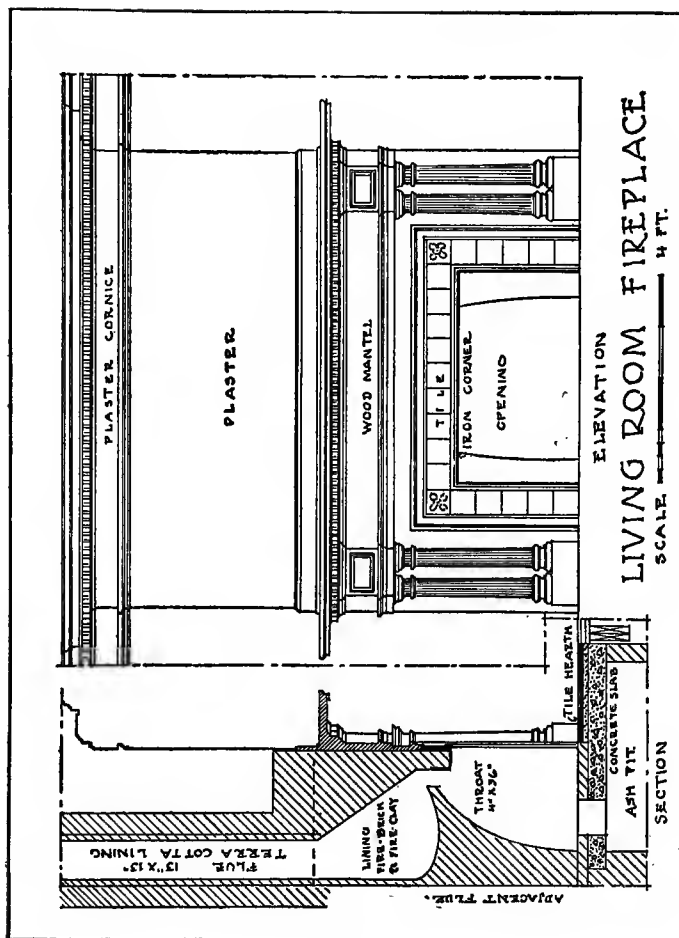


Plate 30
PROPERLY CONSTRUCTED FIREPLACE—See Plate 12

materials. The shelves should not be very far apart,—perhaps ten inches,—and some of the shelves should be made quite wide to accommodate bed clothing and blankets. Medicine cases may be built practically inside of the partition, projecting only a few inches. The shelves do not need to be more than four or six inches wide, and should be, if possible, of plate glass and adjustable, so that they may readily be removed and cleaned. The door of a medicine case may be sixteen inches wide, and twenty-four inches high, and should have a mirror either on the outside or inside.

A very special fixture for a bedroom is a combination lavatory, towel closet and toilet case built in the wall and shut off from the room by means of a door, with a mirror panel on the inside. The space used may be twenty-four inches wide and eighteen inches deep, in which is incorporated the equipment named. All parts must be made especially sanitary, and ventilation of the little closet is advisable. (See Plate 32.)

Dining Rooms.—The important feature of the dining room is the buffet or sideboard. The design may vary to a great extent, but the more pleasing designs consist of a lower projecting part containing drawers and lockers, and an upper recessed part which is open. However, in the upper part, small glass doors may be placed at the sides, while the central portion may have mirror back and ends. It is often very desirable to line all china cabinets with mirrors, and to use plate glass shelves supported by nickel brackets. The doors of such cabinets

should be of plate or of leaded glass, and not of common glass panels. In designing a buffet, the exact use of the fixture should be considered, and space allowed for certain articles of linen, silver, glass and china. It is not well to display too much of such ware. Other cabinets than the buffet or sideboard may be designed into the room, but should probably not project beyond the face of the wall. Thus the upper part of a pass cupboard may become a china cupboard. Sometimes a square dining room may be architecturally treated by placing in each corner of it a triangular china cupboard with plate glass doors and shelves, and mirror backs. China cupboards may be illuminated by concealing an electric light in the upper part, which is not visible but which lightens in a modest way the interior of the cabinet. A sideboard should never be placed on an outside wall with windows at the sides or above, since the light from the outside is disturbing when the gaze is fixed upon the sideboard itself. The size of buffets and sideboards varies in width from four feet to nine, and in height from two to four feet from the floor to the counter.

Dining room fixtures made of wood throughout, including linings and shelves, should be white or a neutral color on the inside, rather than the color of the wood of the room if finished naturally. The edges of wood shelves should be beveled quite thin to avoid a look of heaviness. Quite often the trim or casing of the fixture may be exactly the same as the trim of doors and other openings, and in all cases should match

other woodwork. In some instances, nooks or alcoves have been made in the walls of dining rooms to exactly accommodate a ready-made fixture of family or historic interest. A niche of this type may be semi-circular, semi-octagonal or other shape.

Of the other built-in features of a dining room, perhaps the service table and bay window are most often used. The service table should be by the pantry door, and may be quite small and built part way in the wall itself. Dining rooms on the south side of the house may very often have a special window used as a plant conservatory, which would necessarily require a seat or wide stool. Paneled walls and occasionally plate rails are desirable features. (See Plate 33.)

Kitchens.—As the kitchen itself is a work room, the architectural furniture of the kitchen is designed to be used every day. The small things, then, become important.

All counters and tables in a kitchen should be of the same height so that in placing a dish or a utensil on one table or on another the same movement is anticipated and performed. By this simple arrangement, the chance of accident and breakage of dishes is minimized. In order that the hands or elbows of the worker, whether sitting or standing, may be at the same relative height to the counter, a stool of the proper size should be a part of the kitchen equipment. Adjustable legs on work tables have been found convenient. Counters and tables, when designed for the especial use of one person, should be built to accommodate that one. The conven-

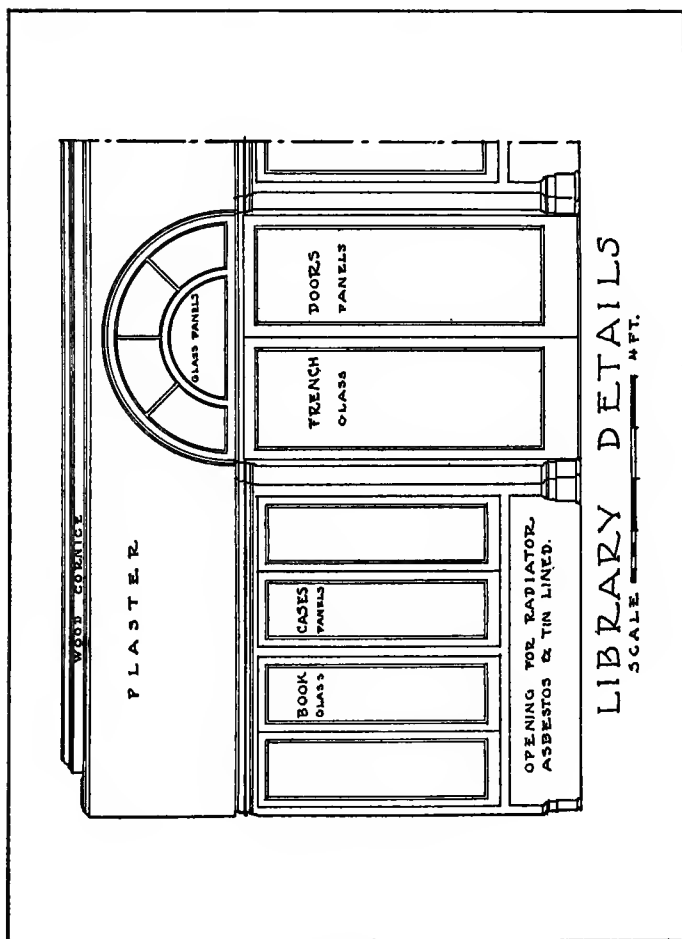


Plate 31
COMBINATION OF FEATURES—See Plate 12

DOMESTIC ARCHITECTURE

ient height for such fixtures is from thirty to thirty-six inches, and it is well to use a dimension approaching the latter figure. The tops of all tables and counters should be of such material as will not readily cause breakage. Of the woods, white pine, red cedar, and perhaps white maple are the best. Oak is too subject to warpage. Tile and slate are serviceable materials for counters but are so hard as to cause breakage of glassware, china and crockery. Perhaps the best material to use for kitchen counters is a patent material consisting of a number of substances which give not only a firm, waterproof surface, but also give elasticity. There are a number of such materials in the market which are put in place similarly to asphalt and allowed to become hard, thereby giving a surface without joints.

Cupboards should be designed to accommodate certain articles. Pantry cupboards are used for staple supplies, and should be roomy. China cupboards may well have adjustable shelves, so that they may be arranged to suit the china on hand. A good width for the shelves of china cupboards is eleven inches. Cupboards used in connection with the main work counter, and sometimes called spice cupboards, should be narrow, with shelves perhaps from four to eight inches wide, but the distance between shelves should be great enough to allow space for bottles and tall cans. One cupboard in a kitchen should be a dry cupboard, which may be built around the hot water tank or against the chimney. Here, sugar and such articles of food may be

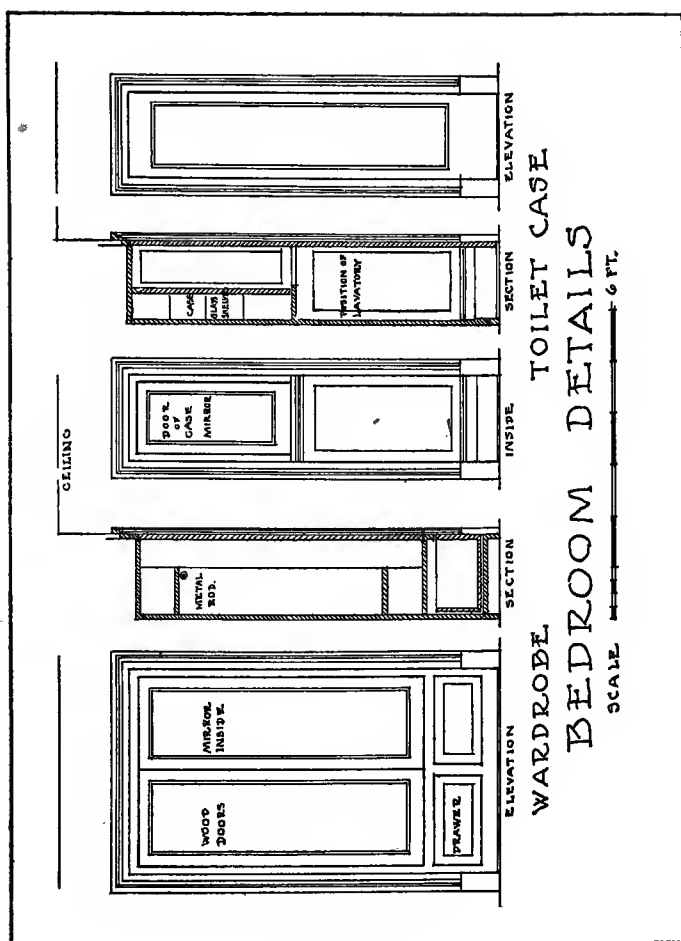


Plate 32
BUILT-IN FIXTURES FOR THE BEDROOM—See Plate 13

DOMESTIC ARCHITECTURE

kept with small chance of damage to them from moisture. A special cupboard should be provided for large utensils used in cooking, such as iron kettles, broilers and the like, which have a limited sphere of use in a kitchen. They should be carried only from sink to range and range to sink and stored in immediate proximity to the sink. Ordinarily a locker under the sink counter with either a shelf or pot hooks is provided for the storage of these heavy utensils, but a far better arrangement is to have the locker above the sink counter to the right of the sink, the drain board being on the left. This locker should really be within the kitchen wall rather than projecting over the counter to give the greatest ease in handling the heavy articles. If other cupboards are not behind the face of the plaster they should extend to the ceiling to eliminate the dusty top shelf so common. The extra space thus provided although high above the floor is useful for storage. It may be mentioned here that shelves over six feet high are not usable in everyday kitchen work.

The doors of cupboards may be made to slide or to hinge, each kind having advantages. Sliding doors, unless very well constructed, are hard to keep clean and if a track is provided at the bottom of the door instead of at the top they are impossible to keep clean. The main objection to hinged doors is the fact that they swing out and interfere with the worker. To minimize this difficulty, hinged doors should never be made more than sixteen inches wide. Cupboard doors may be of wood panel or glass panel con-

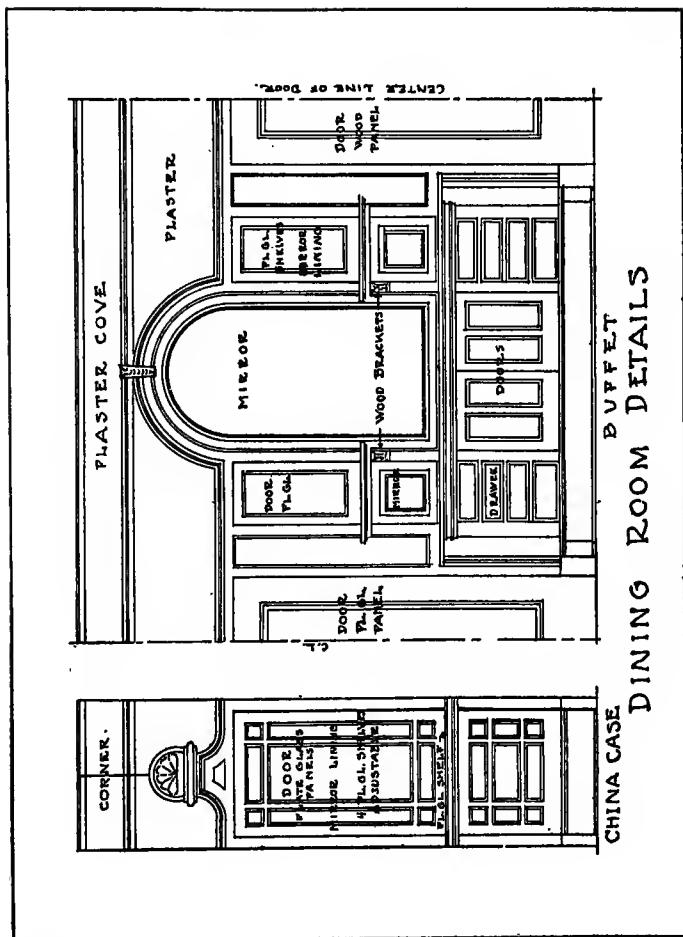


Plate 33
BUILT-IN FIXTURES FOR THE DINING ROOM—See Plate 12

DOMESTIC ARCHITECTURE

struction. Probably the glass panel doors are more convenient because the contents of the cupboard may readily be seen. However, wood panel doors have a neater appearance on account of the unavoidable disorder or at least irregular appearance of the contents of some cupboards. Doors in cupboards built inside of the kitchen wall may often be arranged to slide up into the wall itself, which is a very nice arrangement, and sanitary as well. Doors should never sweep over a counter or scrape on the ledge at the bottom. In the latter case they may be raised a fraction of an inch on a small rail.

The width of counters does not vary to a great extent, it having been found that twenty-two inches is the maximum convenient reach. The higher the counter, the less wide it may be. Counters in pass cupboards or service cupboards, however, may be wider, since they are reached from both sides, but even they should not be more than twenty-eight inches wide, mostly on account of the width of the space above, which could be used only for two sets of shelving, with perhaps doors on both sides. The proper height of detached cupboards above counters, allowing a working space between, is eighteen inches. Drawers should be rather shallow.

In built-in kitchen equipment, the work table or work counter should be provided with bread boards and bins. Bread boards should be constructed to withstand warpage, to maintain a good wearing surface, and to be easily cleaned. Perhaps the best way of constructing such a board is to make it much as a high-class drawing board,

DOMESTIC ARCHITECTURE

consisting of matched white pine strips held together at the ends with oak bindings. A bread board may be eighteen inches wide, and twenty-four inches long, unless it is to be used for some special purpose. In speaking of bread boards it is often well to provide in a kitchen a marble slab which may be conveniently accessible for certain uses. Bread boards slip into a pocket below the counter, but this pocket should not be ceiled on the floor of it at the back, because invariably it will collect dust and crumbs which cannot be reached. By leaving a small opening in the floor at the back, the dust may be brushed into the open space below, and from there removed. For flour and sugar bins, the hopper bin, properly constructed, is the best. At the base of the counter the baseboard should be set in from the edge of the shelf above a distance of about ten inches to allow ample standing room, and even sitting room, since it is impossible to work at a counter when the toes strike the base, causing the body to pitch forward. Near this base the bins are pivoted, allowing them to tilt forward a reasonable distance, and catch, but in all cases the bin should be so constructed that no matter whether it is full or empty, perfect balance will be maintained. In many cases a bin holding one hundred pounds or more of sugar is almost impossible to open when recently filled. All bins should be lined with a removable zinc or tin lining, which may have a small lid of its own. Thus the entire bin may be lifted from its pivots at the base and set into the room, and the niche which it occupies readily cleaned.

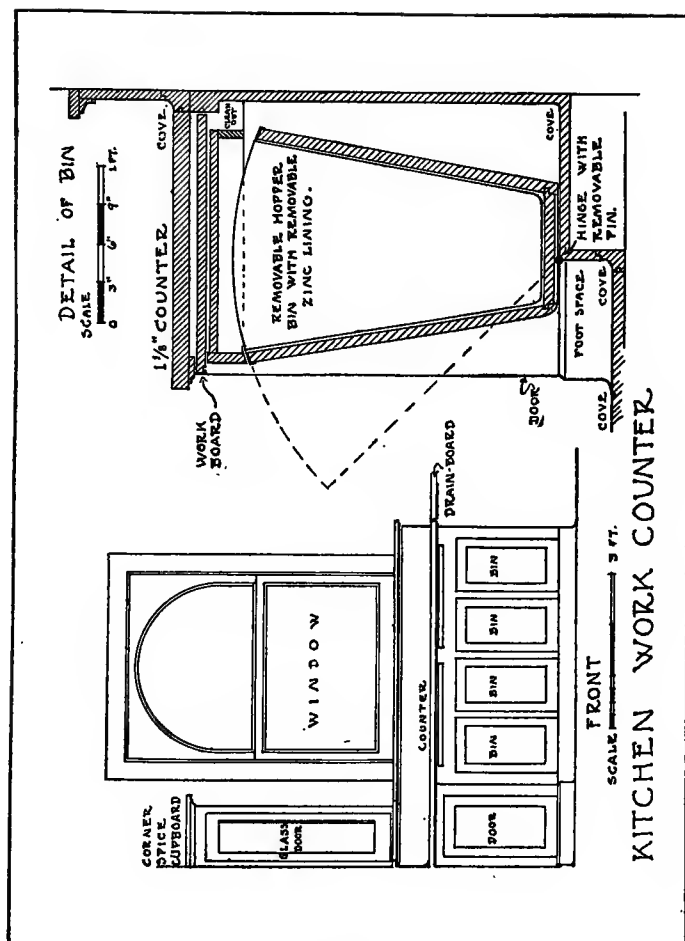


Plate 35
SPECIAL KITCHEN COUNTER—See Plate 12

DOMESTIC ARCHITECTURE

Here would have fallen the dust from the pocket of the bread board above. While the bin is in the room, the lining may be removed and all parts thoroughly scoured. This bin is perfectly sanitary and vermin proof if accurately constructed. (See Plate 35.)

The plumbing work connected with sinks should be exposed. The ordinary sink is of enameled iron, and if of good quality is satisfactory. However, a sink should be set up in such a way that water cannot possibly lodge in crevices and cause an unclean condition. Usually a wood strip in front of the sink may carry across the line of the counter, but at the back an enameled flange should protect the woodwork and should form a base for the faucets. No woodwork whatsoever should be in direct contact with the constantly wet parts of the sink. Drain boards are best constructed of white pine and should be cut with a wide, flat wash in the surface of the level counter, to run the water to the sink, rather than with little grooves, which are apt to be unsanitary. The angles of this sloping cut-out surface should be rounded in order that no difficulty would be encountered in scouring the board. Drain boards belong at the left of sinks, if only one is used. However, drain boards on both sides are preferable, except in the case of small dish washing sinks in pass pantrys.

A very useful piece of equipment in a kitchen is a hood over the range. The purpose of this hood is to carry off all steam and gases generated at the time of cooking. This hood should

be connected with a small special flue in the kitchen chimney, which, on account of the heat of the main flue, has a tendency to draw off all vapors and odors. This hood may be constructed of good sheet iron, and consequently may be cleaned and treated in a way similar to that of the range itself. Kitchens may be provided with a wood lift, and other appliances suggested by local conditions.

A cabinet for a hinged ironing board is a great convenience, if properly located. In moderate climates a cool or ventilated cupboard takes the place of the refrigerator. This is made by constructing an air intake at the bottom and an outlet at the top of a cupboard, and putting in shelves of heavy woven wire, which allow circulation of air. The doors of cool cupboards should be very close fitting. If possible, it is well to have three small ventilated cupboards; one for butter, milk and meat, one for vegetables, and one for cooked foods. (See Plate 34.)

Still another kitchen convenience is a small bookcase for cook books. It may include a desk for keeping accounts, a cash drawer, a telephone counter and a clock shelf, to say nothing of the calendar.

SKETCH PROBLEMS

(1) Copy a colonial fireplace at large scale showing mouldings very precisely.

(2) Design a fireplace for a cottage or a bungalow at the scale of $\frac{1}{2}$ " equals 1'0."

(3) Draw an interior view of a double hung window showing architrave, stool, apron, window stops, sash and glass. Letter the name of each part on the drawing including the stiles, rails, meeting-rail and also the muntins if used. Do not show hardware.

(4) Draw an exterior view of the same window.

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Saylor.—Distinctive Homes of Moderate Cost.

CHAPTER VI. CHARACTER AND MOULDINGS

A **ARCHITECTURAL Character.**—Character is given to a building or to an article of furniture by means of mass, line and mouldings. Mass and line are of such importance as to be the predominating elements in design, but mouldings really give to the structure its individual character. Mouldings are difficult of definition, but may be considered to be continuous bands of ornament having in contour a certain shape made by a combination of straight and curved lines. A moulding in the abstract sense is not constructed of a material but stands for a continuous ornamental surface. In actual construction this surface may be cut in the rough stone face of a building, or, if of wood, may be nailed in place as a ready-made picture mould. The function of a moulding is primarily to ornament; however, mouldings serve various useful purposes. A moulding is judged largely by the shades and shadows that it casts. For instance, a sharp overhanging moulding with a strong light above it produces a deep shadow or strong band of shade, while a flat band with strong light above it, produces a strong band of light surface or high light in contrast to the dark shade. The study of mouldings is highly interesting and among experts the closest discrimination is practiced.

Classical Mouldings.—The classical mouldings, that is, the mouldings originated and used by the Greeks and Romans in their early architec-

DOMESTIC ARCHITECTURE

ture, are of eight kinds with variations. They are called: the band, or fillet; the bead, or astragal; the torus, or tore; the mouth, or scotia; the quarter round, or echinus; the cove, or cavetto; the cyma-recta; and the cyma-reversa. These units are used to form mouldings in general, or belt courses, cornices, caps and bases. Each one is indicated by a small, straight line or curved line representing the cross section of the moulding. The parts are combined according to certain principles, and according to good taste. The use of the fillet, of the astragal, and of the torus is to bind together other mouldings. Some mouldings, as the echinus and cyma-reversa, are strong at the upper part of the curve, and are consequently adapted to support parts above them. Other mouldings, as the cyma-recta and the cavetto, are weak at the upper part of the curve, so are not used to support projecting parts, but to protect the parts below them and thus become crown mouldings. The difference between the astragal and the torus is in size only, the astragal always being very small and the torus very large. The size and even the proportion of all of these mouldings do not by any means remain constant. There is of necessity a dispute in regard to the exact number of mouldings, which, however, is of small import in the study of them. (See Plate 36.)

Orders of Architecture.—From Roman classic architecture there have been evolved five distinct types of columns, with their entablatures and pedestals. Each has a proportion and a combination of mouldings peculiar to itself.

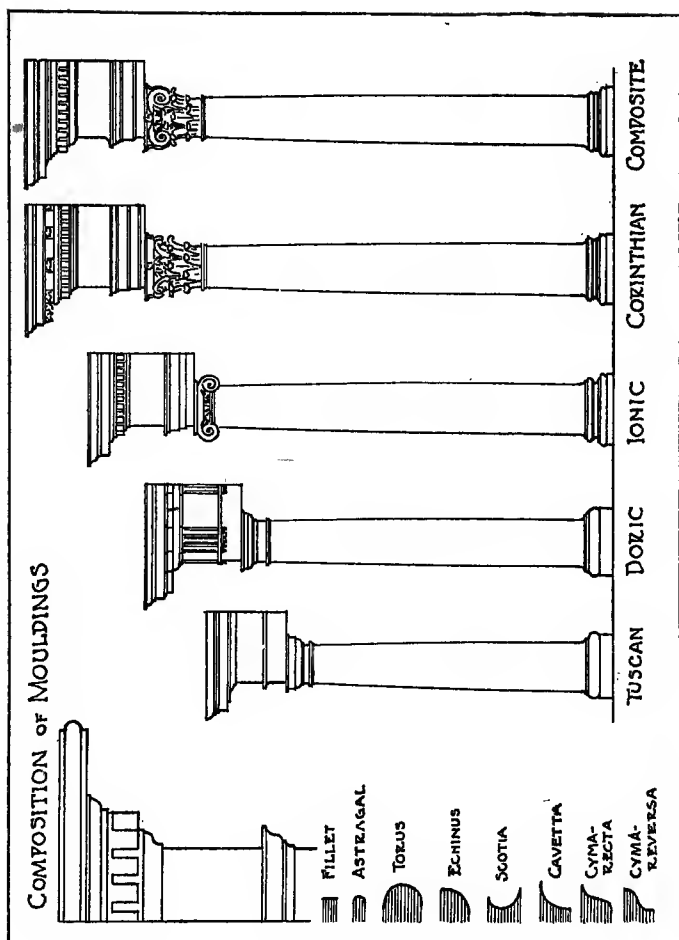


Plate 36

CLASSICAL MOULDINGS AND ORDERS OF ARCHITECTURE

DOMESTIC ARCHITECTURE

These five styles are called the five orders of architecture, which designation is very often not comprehended. An order comprises a column with its base, shaft and capital, an entablature with its architrave, frieze and cornice and may or may not have a pedestal with its base, die and cap. Usually the entablature of an order is approximately one-fourth the height of the column and the pedestal is one-third the height of the column. A column has entasis, that is, the neck of the column is smaller than the base and the line of the column shaft is a convex curve starting at one-third the height of the column. The Roman orders of architecture were investigated and set down by a number of famous architects, chief of whom is Giacomo Barozzi da Vignola, an Italian, whose work was published in Rome in 1563. The book "Vignola" treats of the established proportion and character of the five orders of architecture: the Tuscan; the Doric; the Ionic; the Corinthian; and the Composite. However, Vignola treats also of other forms and combinations of forms employing the orders.

The Tuscan Order.—This order was originated by the Etruscans who inhabited the central part of Italy as early as 750 B. C. Possibly this race was of Greek origin and developed the order from an early Greek type. The Tuscan order is the most massive and simple of all. Assuming the diameter of the column as a unit of measurement, the column is seven diameters high, and the entablature is one and three-quarters diameters high. The pedestal

when used is one-third the height of the column.

The Doric Order.—The Doric order used by the Romans was developed directly from the Doric order used by the Dorians who occupied Greece proper. As used by the Grecians, the column was only from four to six diameters high and the entablature was two diameters high. Also the column was set upon the stylobate, a platform three steps high, and did not have a base of its own. The channels in the column reached to the floor of the stylobate. The best example of the Greek Doric order is found in the Parthenon, a temple of Athens dedicated to Athena Parthenos, designed by Ictinus and Callicrates, and erected in the time of Pericles, 438 B. C. The Romans gave to the column a base, and made the column eight diameters high and the entablature two diameters high. They also modified the minor proportions and changed the mouldings to quite an extent. The main features of the Doric order are the triglyphs and mutules in the entablature. However, there are two types of this order one of which has dentils instead of mutules. The triglyphs are commonly supposed to be derived from the ends of beams and the mutules from the ends of rafters used at a remote time when the order was constructed of wood. Since all columns have entasis it is possible that originally tree trunks were used for posts and columns with a wood superstructure, and that the order was later made of stone, retaining its first form.

DOMESTIC ARCHITECTURE

The Ionic Order.—Like the Doric, the Ionic order originated in Greece. There the Ionians, who occupied the western coast of Asia Minor, were greatly influenced by the Assyrians and Persians, so that the characteristic feature of the Ionic order, the scrolls which practically form the capital of the column, is derived from Assyria. Usually the four faces of the capital were made alike, having double scrolls on each corner, but there are many variations in details. Above the scroll was the crowning member of the capital, and below the scroll was the echinus and necking. The proportions of the Greek order varied, but the entablature was about two diameters high as in the Doric order. The Roman Ionic order, as established by Vignola from many examples, has a column cap in which the abacus and fillet extend on two sides of the column and are rolled, so to speak, into scrolls which enclose the echinus below. Above the scroll is a cyma reversa and fillet. The necking below the echinus is not present, the column extending on downward. The Ionic column is nine diameters high and the entablature is two and one-quarter diameters high.

The Corinthian Order.—The Romans devised an order called the Corinthian, which was very elaborate and delicate in proportion and detail,—even more so than the Ionic. The cornice was supported by brackets called modillions, and the bed mould of the cornice was enriched with dentils. The capital of the column was bell-shaped and very ornamental, having for its motif the acanthus leaf. The modillions, as

well, were decorated with the acanthus. This order was the favorite of the Romans, being used in the majority of their buildings. The column is ten diameters high and the entablature is two and one-half diameters high.

The Composite Order.—Still another order was used by the Romans, called the Composite. It is a cross between the Corinthian and Ionic, having the proportions of the former. The capital of the column consists of an acanthus leaf motif combined with the scrolls used in the Ionic order. In the opinion of many this is the most dignified order.

The Use of the Orders.—In all classical buildings one or more orders of architecture were employed. Sometimes orders were placed one above another, in which cases the more massive orders were placed below. This arrangement was called superposition. Orders of architecture were used in colonnades, arcades, and as single columns standing alone, such as the Column of Trajan, which is 147 feet high. In fact, orders were used in every conceivable way, in connection with all architectural forms, and sculpture was everywhere the closely allied art.

Although the classic style has at various times been revived and developed only to fall into decadence and disuse again, strange to say, it still persists and recurs constantly in the architecture of the world. The original orders are the source of each new inspiration. The present day use of the orders of architecture, commonly reduced to walls and cornices, is in evidence on all sides. The entrance porch of a Colonial

DOMESTIC ARCHITECTURE

house comprises an order as does the mantelpiece of the fireplace, if in its construction a column and a cornice is used. In practically every structure the base, the shaft and the cornice constitute an order, and in many cases the order either emulates or suggests one of the five Roman orders of architecture.

Eccentric Mouldings and Ornament.—Each historical style of architecture had mouldings and ornament peculiar to itself in a greater or less degree. The Gothic style may be said to be a distinct departure from the classic style, although the former really developed from the latter. Gothic mouldings are usually sharp and deep, casting strong shadows, and are usually coarse or large in scale. The chief forms used are beaks, beads, splays, under-cuts, hollows, three-quarter rounds and beveled edges. New mouldings and combinations of mouldings are being made every day to meet certain conditions or satisfy certain individual tastes. (See Plate 37.)

Architectural ornament is a subject in itself. The Egyptians used the lotus plant and palm in a conventionalized form and occasionally the vulture and lion form. The Assyrians used the animal form more than the plant, so that bulls, horses and lions are found in their sculpture. The Greeks and Romans developed the art of sculpture to a high degree and favored the human figure as a subject, but of course used all other known forms. The authors of Gothic architecture used growing plant forms as a motif, which well suited their progressive style or form of building. They also used grotesque

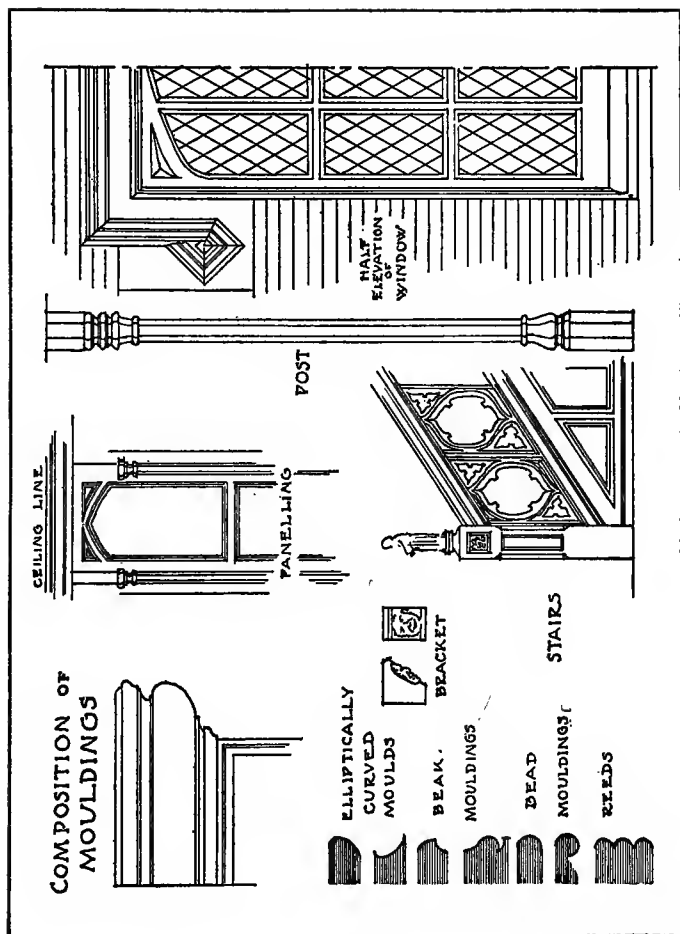


Plate 37
GOTHIC MOULDINGS AND FORMS

DOMESTIC ARCHITECTURE

forms, such as gargoyles, which probably came about through lack of skill in the original sculptors themselves, rather than through any humorous sense. Later architecture is largely ornamented with geometrical patterns and designs. In all architecture the frieze has been used for ornament, especially relief work in stone or plaster, but sometimes other decoration, such as mosaics and painting. It may be said that in early times sculpture, painting and like arts were subservient to architecture, and only in comparatively recent times have they been independent. The æsthetic sense is always in evidence in architecture, even though sometimes almost overwhelmed by the practical. In dire extremity it may show itself in little brackets, rafter ends and sawed or carved edgings, especially in the houses of the masses throughout the world.

Character of Colonial Houses.—Since Colonial architecture is classic by reason of its derivation, the forms and mouldings of the orders of architecture must be employed. The main cornice of the building, assuming that the house is of correct proportion, is the most important feature determining its character and marking the building as Colonial. This cornice should be very properly designed almost according to rule of Vignola, but of necessity adapted to conditions such as material. The wall of the building becomes the shaft or the column of the order relatively and may be treated by actually applying pilasters on its face, especially at the corners. When a two-story porch is added

to the house the order is complete in itself and the lines of the order are the same in both the porch and the body of the house. Examples are very plentiful. In the design of small porches for the house it is again necessary to employ an order and use classical mouldings. In the case of a Colonial cottage with the main cornice at the height of the second-floor level the same order should be used for it as for the porches. Dormers, windows and doors may be designed in which one of the orders is used. In such details an order is more often suggested by the lines and mouldings rather than worked out literally. Also certain door and window treatments employed by original users of classic architecture in connection with the orders have come to be used by us and are established in that way as Colonial. A thorough study of the exteriors of historical examples of colonial architecture is the only way to acquire familiarity with exterior design, since the style is essentially historical, and more than that, historically American. (See Plate 10.)

The interiors of Colonial houses both old and new have been treated in an almost conventional manner. A radical departure would not be pleasing, unless, perhaps, precedent were abandoned and the house designed according to other ideas, in which case it would no longer be Colonial. The mantelpiece should be a composition embodying the principles of classic architecture, but could be very plain or very elaborate to suit the place. The same is true of all other architectural furniture and fixtures

DOMESTIC ARCHITECTURE

which should be strictly Colonial in design. Interior room cornices, whether of wood or plaster, should have the Colonial character. Wainscotings, baseboards, architraves and especially doors and windows must be carefully worked out to conform to other parts. All mouldings in Colonial work are exceptionally small or fine. The scale is small. The relation between the detail of the entire fireplace and the doorway opposite; between the doorway and window; between the window and the cornice in the room,—all must be harmonious and pleasing. A very special detail in the Colonial house is the staircase. Quite often the balustrade forms a spiral around the newel post, which is supported upon winding steps at the base of the flight. The balusters may be delicate spindles, enameled white, while the hand rail may be daintily carved or turned from mahogany.

Character of Miscellaneous Styles.—The exterior of an English house is practically unmistakable, but the variations in design limitless. In an attempt to imitate any one of the period styles of England, thorough study of examples is essential. However, the chief characteristics of the American English house are a steep roof, half timber construction, brickwork in Flemish bond, English Gothic mouldings and exterior and interior features peculiar to English architecture. (See Plate 37.)

Bungalow and modern mission domestic architecture are distinguished by the lack of mouldings, sawed details of construction taking their place both outside and inside. On the outside,

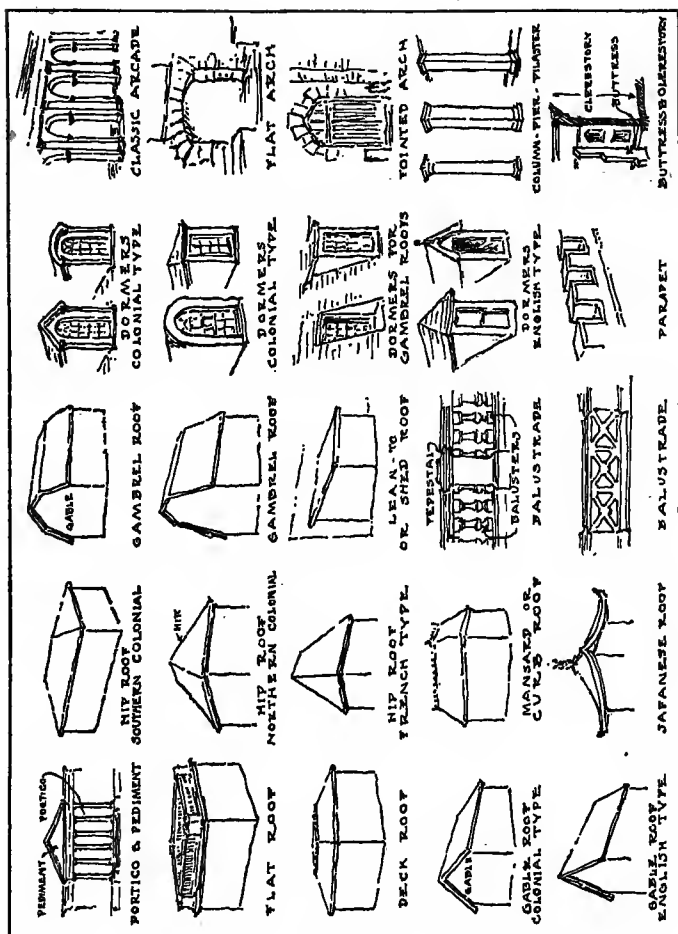


Plate 38
DIAGRAMS SHOWING EXTERIOR FORMS

DOMESTIC ARCHITECTURE

barge boards, sawed rafter ends, sturdy brackets and outlookers, solid posts and severe trim in general are very much in evidence. On the inside, plain board trim, heavy fireplace mantels, and substantial furniture are characteristic of the style. In regard to design, a bungalow should be kept close to the ground and may spread out in a number of irregular low masses. The materials employed are plaster and stained woodwork for the most part, but other materials may be incorporated. As a matter of fact, Japanese forms and details have been imitated in bungalow design, and may be used effectively. They are much finer than the original forms. (See Plates 18, 21, 28.)

It is not necessary in the design of a house to adopt a style of architecture. A building may be given character individually. In fact, no matter how well the characteristics of a style are set forth in a particular house, that building should express character in itself. This is accomplished after much study by a careful combination of forms and mouldings and an infusion of personality and individual usefulness into the design.

Sanitary Mouldings and Treatment.—In kitchens and bathrooms, and sometimes other rooms, it is desirable to have exceptionally sanitary conditions. Besides having the walls, ceiling and floor of the room in question smooth and hard, it is necessary to avoid nooks and crevices in the general arrangement of the equipment and especially in the woodwork. As far as possible, mouldings should be avoided and

smooth trim used, but where necessary, mouldings in the form of bands and coves may be used. These mouldings may be so placed as to practically eliminate cracks and sinkages which collect dirt. Coves set flush in the angle made by the baseboard and the floor and in all other angles subject to unsanitary conditions are very advantageous. The trim for doors, windows and fixtures may be perfectly smooth bands or casings. Projecting high ledges and tops of fixtures which collect dust should be eliminated.

Conclusion.—Character and mouldings is a subject upon which much may be said and little comprehended without actually studying architectural design and doing original work. This means years of application to a specialty and amounts to architecture as a profession. One fact may be repeated,—that character is given to a building or an article of furniture by means of mass, line and mouldings. To do this unerringly, all of the principles of design and composition must be in the mind of the designer.

SKETCH PROBLEMS.

(1) Draw two columns and an entablature, using the Doric order. Let the sketch represent a small entrance to a Colonial house. The columns may be eight feet high. Use $\frac{1}{2}$ " scale.

(2) Copy a Gothic staircase.

(3) Draw a cross-section of a sanitary picture mould, chair rail and baseboard. Show how they are applied to adjacent parts and held in place.

REFERENCES

Ware.—The American Vignola.

Robinson.—Architectural Composition.

Fletcher and Fletcher.—A History of Architecture.

CHAPTER VII. COMMON BUILDING MATERIALS

BUILDING Stones.—Stone as a building material has been used extensively in all ages. The common stones now in use are granite, limestone, marble, sandstone, and slate. Granites are massive rocks composed principally of quartz, mica and feldspar in varying proportions. Granites containing a large amount of quartz are very hard, but when containing a considerable portion of feldspar are easily cut. Granites vary in color from light to dark gray and from pink to red, the colors determined chiefly by the feldspar. Although granite is quite easily cut into blocks, it is extremely tough for cut stonework. This stone is used especially for columns, steps and bases for large buildings. Stones may be secured of practically any size. The chief states in which granite is quarried are Maine, Vermont, Massachusetts, Connecticut, New Hampshire, Rhode Island, North Carolina, Georgia, Missouri, Wisconsin, Maryland, New Jersey, New York, Pennsylvania, Delaware, South Carolina, Colorado and California.

Limestones may differ to a great extent in origin, structure and color. Besides carbonate of lime, they contain carbonate of magnesia, iron, silica, clay, bituminous matter, mica or talc. Most of the stones are originally derived from deposits built up of shells, fossils, and like marine materials. The color is light gray, dark blue, cream or buff, and most stones will take a high polish. This stone is a very practical and

DOMESTIC ARCHITECTURE

substantial material for window sills, and other stone trimmings. However, it does not withstand a great amount of heat. The chief states in which limestone is found are, first of all, Indiana, where Bedford stone is quarried, and Alabama, Arkansas, Colorado, Florida, Illinois, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, New York, Ohio, Pennsylvania and Wisconsin.

Marble is a limestone in a crystallized state, and therefore capable of taking a better polish than limestone. Marbles are rather scarce, hard to quarry, and subject to staining when used outside, on account of iron oxides in them. They are especially adapted to carving. The common use of marble is as a veneer on inside walls, so it is cut in very thin slabs and applied by means of a cement. Slabs are usually only an inch or two thick, and are set up in such a way as to match in case there is a decided streak or figure in the slabs. Much of the marble used in the United States is imported from Italy, and from Mexico. Tennessee, Vermont, New York, Massachusetts, Maryland, Pennsylvania, California, Alabama, Washington, Arkansas, Nevada, Utah, Wyoming, New Mexico, Missouri and Alaska produce marble in considerable quantities. Of these, Vermont is the greatest producer.

“Sandstones are composed of rounded and angular grains of sand so cemented and compacted together as to form a solid rock. The cementing material may be silica, carbonate of lime and iron oxide or clay matter.” Sandstones

are used more extensively than any other stones as a building material, and are found throughout the country. The quality varies to a great extent, the sand in all cases being of pure quartz, but the cementing material being composed of different substances which may or may not be substantial. The most objectionable cementing material is clay, the stone being liable to decomposition on account of moisture and frost. The colors are drab, blue, buff, gray, brown and pink, and are due largely to the iron in the composition. Oxides of iron in any building stone are liable to cause stains if used on the exterior of the building. The texture of sandstones varies from very fine to very coarse grain. The fine-grained stones are the best in every respect.

Slate is used principally for covering the roofs of buildings. However, it is used also for blackboards, table tops and miscellaneous purposes. Ordinary roofing slate is compact, silicious clay. A peculiar characteristic of slate is its tendency to split into very thin sheets, with surfaces so smooth as to be made to fit closely together, which with its strength, toughness and imperviousness to water cause it to be a valuable material for shingles. Slate varies in color to a considerable extent, being black, blue, purple, gray and green. In a few localities red slate is found. A fine grain in a slate is a good quality. The cutting of the shingles should be with the grain, so that in case the shingle splits, the piece will probably remain in place. This material is produced in Pennsylvania, Vermont, Maine,

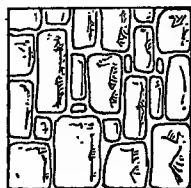
DOMESTIC ARCHITECTURE

Virginia, Maryland, California, New York, Arkansas and Georgia.

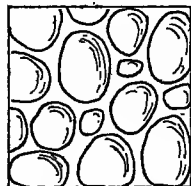
Of the other building stones, tuffs is of some importance, being of volcanic origin and sometimes called lava stone. It is very light in weight, on account of its porosity. Blue shale is a variety of sandstone, used slightly. Trap is a hard rock suitable for foundations. Soapstone is a very soft rock used sometimes for sinks.

A wall may be of solid stone, or may be of stone facing with a background of brick or concrete. Stone facing is called ashlar. The common types of solid stonework are rubble walls, made of undressed rough stones bonded securely together, and usually laid at random, and field stone walls, made of small round boulders. The methods of joining are many, in some cases the rough stones having a sort of pattern, and in other cases the stones having an arrangement called for by the shape of the stone itself. Solid stonework of these types is used especially in rustic buildings and walls for retaining earth and for fencing purposes.

Ashlar is laid as broken ashlar and coursed ashlar. By broken ashlar is meant the use of stones of different shapes and sizes, which are fitted together at random, but which have been especially cut for the purpose. By coursed ashlar is meant the laying of stones according to a certain pattern, which may be regular plumb bound, irregular plumb bound and other combinations using stones of one size, two sizes, and three sizes, up to six or eight certain sizes. The face of cut stonework may have a number of



UNDRESSED RUBBLE
RUBBLE



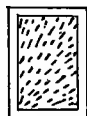
FIELD STONE
WALLS



ROCK FACE



BUSH-HAMMERED
WITH MARGIN



POINTED
WITH MARGIN



VERMICULATED
WITH TOOLED MARGINS

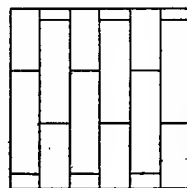


TOOLED

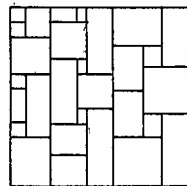


FISH - SCALE
TOOLED MARGINS

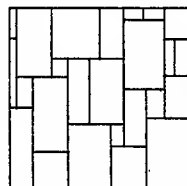
STONE FINISHES



REGULAR PLUMB
ASHLAR



RANDOM COURSED
STONE WALLS



BROKEN,
STONE WALLS



RUSTICATED
JOINTS IN



POINTED
STONE WORK

Plate 39
STONEWORK

DOMESTIC ARCHITECTURE

finishes made by the use of different tools. Of these finishes the common ones are rockfaced stonework, in which the face of each stone is left in the rough; pointed stonework with a margin, in which the face is pointed with a tool and the margin left smooth; tool stonework, in which the face of the stone has small vertical ribs; bush hammered stonework in which the surface has been pounded with a bush hammer; vermiculated stonework, in which the surface is treated as though it had been worked upon by worms; and fish scale stonework, in which the surface has been hammered to look like scales.

Stones are cut in every conceivable shape and pattern to form architectural features such as arches, quoins, lintels and sills. The joints are pointed with mortar, and may be raked out to a cove or set off as a bead, and sometimes given other shapes for the sake of effect or to turn water. (See Plate 39.)

Bricks.—Bricks were first used by the Egyptians, being made of mud baked in the sun; later they were burned similarly to the present method and employed extensively. The Assyrians developed them to a high degree and made ornamental brick friezes on the interior of their palaces as well as walls, pavements and other features. At all times they have been an important material, but in early times were used more as a solid structural mass upon which to secure costly marble, stone and alabaster, than as a finish material. Since the time of the Roman Empire bricks have gradually assumed a vast importance as a surface material, the greatest

strides in the improvement of them having been taken in recent years.

Bricks are extensively used as a building material throughout the United States, nearly every locality having a brickyard of its own. The kinds of brick are much varied, depending upon the clay used and the method of burning. Ordinarily bricks are made of a mixture of clay and sand, to which foreign substances have been added to give the product certain characteristics. Bricks are moulded, or pressed, from soft or stiff mud, either by hand or by machinery, and after being dried are burnt in a kiln. This process varies chiefly in the draft of the kiln, whether up or down, and in the arrangement of the stack of dry bricks which are to be burnt. In the burning process, the bricks farthest from the heat remain rather soft and light in color and shrink less than the others.

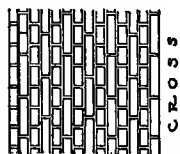
Common bricks, used for backgrounds and protected walls, are soft, porous and cheap in price. Paving bricks are extra large, hard and strong. They usually have rounded edges and are vitrified or made impervious to water by burning to a vitrified state, this being brought about by the fusion of the silica and other ingredients of the clay. Fire bricks, used to line furnaces, chimneys and fireplaces, are porous and infusible. They are made of raw flint clay and plastic clay. Face bricks are of many kinds including glazed and enameled bricks, pressed bricks and moulded bricks. Glazed bricks are made by applying to the two finished sides during manufacture a coat of "slip" made of ball-

DOMESTIC ARCHITECTURE

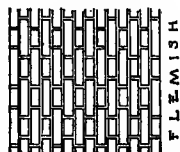
clay, kaolin, flint and feldspar, and a coat of glaze. The substance composing the glaze fuses and becomes transparent, leaving the bricks the color of the "slip" which may vary. Enameled bricks are made by applying a coat of enamel to a burned or unburned brick and fusing the coating by heat. The enamel is opaque and gives to the bricks color. Pressed bricks are made in a dry-press machine and are very even in size with true edges. They may be of any brick color. Moulded bricks are special forms of pressed bricks used for arches, cornices and circular walls.

Texture in bricks and brickwork is important. A very pleasing texture for a brick is acquired by splitting the wet clay with a coarse wire, thereby making bricks each with a wire-cut end and side. This is called a wire-cut brick, the surface having a rough, dragged finish in which the particles lean in the direction that the wire passed through. Other textures are acquired by the use of acids and peculiar methods known only to the manufacturers.

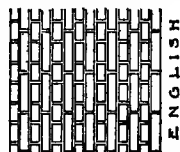
The color of bricks depends largely upon the composition of the clay used in the manufacture of them, and also upon the temperature of the kiln, or parts of the kiln. Pure clay produces a white brick. Oxide of iron causes bricks to be from red to purple in color. Iron and lime produce in bricks a cream or drab color. Magnesia brings about a brown, while magnesia and iron together bring about a yellow color. Certain colors are produced purposely by mixing clays, applying mineral pigments to the surfaces before



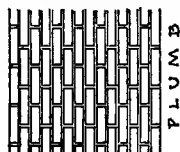
CROSS



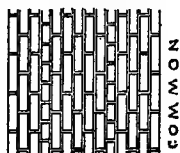
FLEMISH



ENGLISH

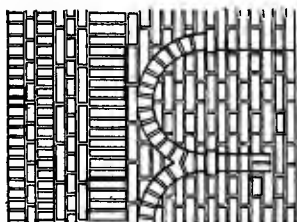


PLUMB

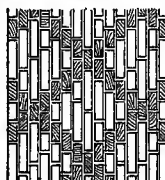
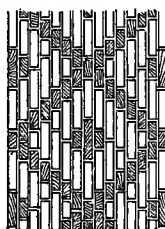


COMMON

BRICK BONDS.



BRICK CORNICE.



BRICK SURFACE PATTERNS

burning the bricks and by adding chemicals or mortar colors to the clay in the dry pan.

The standard size of common bricks is $8\frac{1}{4} \times 4 \times 2\frac{1}{4}$ inches; of face bricks is $8\frac{3}{8} \times 4 \times 2\frac{3}{8}$ inches; of paving bricks is $8\frac{1}{2} \times 4 \times 2\frac{1}{2}$ inches; and of Roman bricks, distinguished by this size, $12 \times 4 \times 1\frac{1}{2}$ inches. However, the actual sizes of bricks vary to such an extent that it is necessary to measure each kind and lot of bricks to go into a building before establishing the exact dimensions for the parts of the building related to the brickwork. A stretcher should be the same length as two headers and a mortar joint and also the same length as three brick courses laid in place in order that bricks fit well in the wall. A brick is said to be approximately $8 \times 4 \times 2$ inches in size and to weigh five pounds.

Patterns on the surface of brick walls, called diaper work, are quite common, and beautiful examples may be seen in Italy, England and other places. Surface patterns are made by the arrangement of the bricks and the use of, perhaps, a number of shades or colors. The bond in brickwork is especially important. Bond serves the purpose of holding the bricks substantially together, and also of giving a pleasing effect to the wall. Among the bonds used are the common bond, plumb bond, Flemish bond, English bond, and cross bond. Numerous other bonds are invented and employed in individual cases by architects. Brick joints are like stone joints, and may be struck with a drip for water, may be raked out or may be pointed flush with the wall. (See Plate 40.)

Terra Cotta.—Terra cotta is a building material made by moulding clay according to a certain given design, and burning it similarly to bricks, but it is a more finished product. A good clay, which when fired will partially vitrify, is required. The surface of terra cotta is treated in a number of ways, chiefly by painting with a substance before firing, which will give it color and the quality of resistance to moisture and gases in the air. Practically any required color or combination of colors may be attained.

Terra cotta as a building material has made great advancement in the last few years. It is a material in itself and not an imitation, so that it should be used as such rather than in imitation of stone. Terra cotta is especially good for the facing of down town buildings, on account of its durability, beauty and cheapness, and may be used in conjunction with brick. It has come to be used satisfactorily in residence work as well, especially in the formal type of house. For fireplaces, urns and garden features it is very serviceable.

Tiles.—Tiles are a clay product made according to the ceramic principles employed in the manufacture of bricks and terra cotta. They are made in a number of shapes and for different purposes. Roof tile, although made in many styles, has the characteristics of slate, lapping one over another and made impervious to water. The colors usually employed for roofing tile are red, green and gray.

Tiles are also used for conducting water underground. These are common drain tiles for

carrying off seepage water and vitrified sewer tile for carrying off sewage. The latter is always laid in cement mortar to prevent leakage of gas from the drain.

A very important building material is terra cotta hollow tile. This is of a number of makes, and consists of hollow tile blocks thick enough to form a wall when laid one above another in a bed of cement mortar. The sizes vary for different kinds of walls, since outside walls may be a great height in some buildings, and must necessarily be thick. For partitions the tiles are usually only four inches thick. Tiles of similar make are used for floors so that practically a whole building may be constructed of tile which would make it nearly fireproof. In tile or other fireproof construction there are usually some parts that are inflammable, such as finish woodwork. Tile construction requires skilled workmen familiar with the nature of the material and the methods of erecting such a building, so that it will be substantial. Hollow tile walls may be plastered outside and in without much danger of dampness or disfiguration of finished surfaces on account of dampness.

Concrete.—The use of concrete was known to the Egyptians, Romans and other early builders. They probably used a natural cement with sand, gravel and water to produce it. Not only did the Romans build concrete aqueducts, buildings and roads but they also plastered their walls with a cement plaster much like our own modern product. Many examples are still in evidence, showing the permanence of their work. In fact

the Romans at one time almost depended upon plaster as a wall finish both inside and out.

Concrete is an exceptionally useful material for footings, foundations, walls, floors and walks subject to hard usage. Common concrete is made by mixing Portland cement and sand together dry, which composition is mixed with gravel or crushed rock and water. The whole substance, while still freshly made, and very soft, is poured into plank forms, holding it in place, where it is allowed to remain for several days and set into a hard monolithic mass. The quality of concrete is determined by the proportion and quality of the ingredients. For very strong concrete work one part of cement, two parts of sand and four parts of gravel are mixed together with water and allowed to set. For very weak concrete, one part of cement, three parts of sand and seven parts of gravel may be used. For ordinary foundation walls used in houses, a mixture of 1:3:5 is perhaps economical and perfectly safe. Wearing surfaces on floors should be put on separately from the mass of concrete but not after the mass is hard and dry. It should be applied evenly and jointed three-quarters of an inch deep to prevent cracking in other places than the joints since in contraction and settlement of the floor there is necessarily a shrinkage. These joints are the same as regular expansion and contraction joints in larger concrete works. A wearing surface should be composed of one part of cement and one or two of sand.

Reinforced concrete work has assumed a vast

DOMESTIC ARCHITECTURE

importance in recent years, and is constructed by using steel bars enclosed within the concrete mass to give it tensile strength. Columns, beams, floor slabs and arches are made in this manner. The fundamental principle of reinforced concrete is based on the fact that concrete and steel expand and contract in the same ratio under various conditions of heat and cold, thereby preventing the breakage of either the one or the other with the shrinkage or expansion of the whole mass.

Concrete is ordinarily the cheapest form of masonry construction when used as common concrete for walls and floors. A handy material but one lacking character is the ready-made concrete block usually manufactured to imitate stone.

Wood.—Wood is the most common building material, and is used extensively for practically every purpose. Woods may be classified as endogens or inside growers and exogens or outside growers. The former include bamboos and palms growing as a single stem which does not become larger with age but only longer. The latter include all broad-leaved trees and conifers or needle-leaved trees. The exogens grow in the following manner: Wood structure consists of cells. These are pores running the length of the wood and pith rays running at right angles to the trunk of the tree from the bark to the pith in thin sheets. When the tree begins to grow in the spring the new cells formed by the sap are large and thin-walled but late in the summer the new cells formed are much

denser. Thus spring wood is light in color while summer wood is relatively dark, enabling one to distinguish the ring of growth around the trunk of the tree by which the age of the tree may be ascertained. As the tree grows older the cells toward the centre of the trunk become hard and dark in color and are no longer useful for the growth but for the supporting of the increased weight of the tree. This inner cylinder of wood is called "heartwood." The outer cells continue to convey sap necessary for the growth of the tree and remain for a while soft and light in color. This outer belt of wood is called "sapwood." Sapwood is, then, immature heartwood. In tropical woods that grow continuously, rings of growth are not discernible and in some trees, such as basswood, heartwood and sapwood are hardly distinguishable. By lumbermen timber is classified into "hard woods" and "soft woods," but some of the hard woods are not really as hard as some of the soft woods. (See Plate 41.)

The hard woods are said to be porous woods. When large pores develop early in the season and small pores late in the season, the wood is ring-porous as is the case with hickory, oak and ash. When small even pores develop throughout the season, the wood is diffuse-porous as is the case with maple, walnut and birch. The soft woods are said to be non-porous. The grain of hard woods brought about by annual growths according to the nature of the tree is usually fine and irregular while of soft woods it is coarse and even. The term "grain" refers to the lines

DOMESTIC ARCHITECTURE

visible to the naked eye in a piece of finished lumber. In general, hard woods are more durable, handsome and costly than are soft woods.

In regard to the preparation of lumber for building purposes the first operation consists of selecting and felling trees of the forest which are sent in the form of logs to a mill to be sawed into proper and convenient sizes and shapes. Among the defects in logs may be mentioned shakes, which are cracks in the heartwood, often star-shaped, brought about by contraction of the old wood; large knots which mark the source of growth of limbs of the tree; and decay of the heartwood. Heartwood rots only when exposed to the air by the failure of some other part of the tree. Logs are sawed in two ways:—common and quarter-sawed. By common sawing is meant the cutting of the entire log into thin slabs. By quarter sawing is meant the quartering of the entire log and cutting each quarter into slabs, taking care to saw in the direction which will cut through the annual rings of wood. All high class logs of hard wood and occasionally of soft wood are sawed in this manner, and unless thus manipulated are not desirable. In common sawing, a large amount of the lumber is necessarily sawed almost horizontally to the rings of growth, thus producing a coarse-grained surface in the lumber which is readily discernible. In common sawing, the lumber sawed vertically to the rings of growth is exactly like quartered lumber and is usually selected for flooring and other purposes. It is called “edge-grained” lumber. (See Plate 41.)

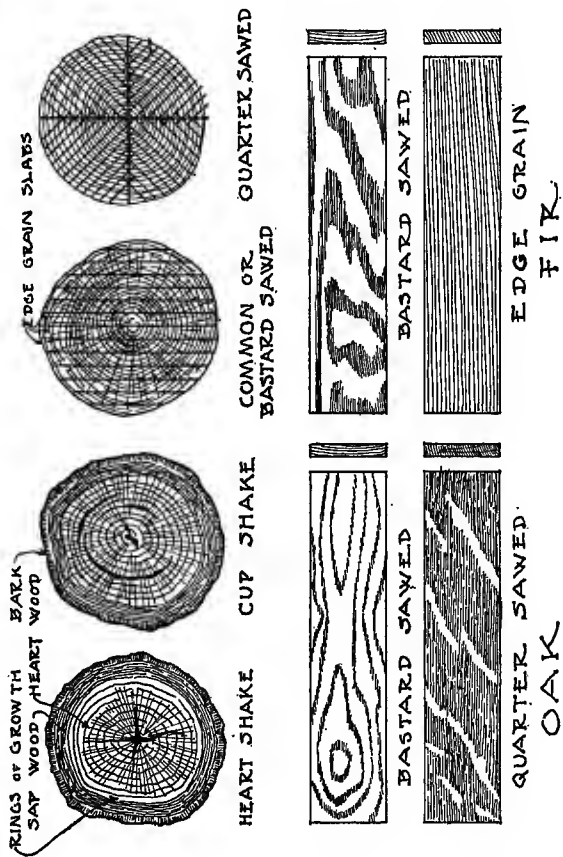


Plate 41
 Wood

Timber is seasoned by evaporating the moisture from the pieces, either naturally or artificially. When seasoned artificially, the lumber is stacked in a kiln and a current of hot air is made to pass through it until the moisture is evaporated. Lumber is tested for moisture by weighing, and since the weights of woods are known, it can readily be determined when all of the moisture has been removed. Dry wood will absorb water very readily, so that it is necessary to protect finishing wood at all times, even when nailed in place in a building. Wood has a great tendency to shrink, the shrinking process continuing in many cases for a year or more, depending upon conditions. Hard woods more than soft woods have a tendency to warp when one side is exposed to moisture or heat. Shrinkage in wood is a trait which must be considered at all times when working with it. To avoid warping and shrinkage, it is necessary to have the wood carefully seasoned before manufacturing articles from it, and to protect the article when finished.

Of the hard woods common in the United States and used for structural purposes the following are described in the approximate order of their hardness:

Shellbark hickory grows throughout the east central states. The color is reddish brown except the sapwood which is quite light. The wood is very heavy, very strong, very elastic and very hard. It is used especially for implements that require great toughness of material, but it is also used for household furniture.

Black hickory grows in the eastern and south-eastern states. It is dark brown to white in color. The grain is straight and close. The wood is very heavy, very strong, very elastic, and very hard. It is used much as shellbark hickory and is confounded with it but is not as good.

White oak grows throughout the eastern and east central states. It is light brown in color and crooked in grain. The wood is heavy, strong, elastic and hard. White oak is the most important hard wood and is used for interior finish, furniture, shipbuilding, implements and framing.

Western white oak grows in western Washington and Oregon. The color of the wood is light brown and the grain very close and crooked. It is heavy, strong, medium elastic, and hard. Unless carefully seasoned it warps badly. On the Pacific Coast it takes the place to some extent of white oak and is used similarly.

Bur oak grows in the Mississippi valley. It is dark brown in color and crooked in grain. The wood is heavy, very strong, elastic, and hard. It is used for shipbuilding, cooperage, and cabinetwork. In commerce it is not especially distinguished from white oak.

Red oak, black oak, basket oak, and post oak grow chiefly in the eastern part of the United States, each having distinguishing features but used much as are other oaks.

Black locust, also called locust and yellow locust, grows chiefly in the Allegheny Mountains but is found elsewhere. It is brown in color and crooked in grain. The wood is heavy, very

DOMESTIC ARCHITECTURE

strong, elastic and very hard. It is used for shipbuilding, general construction, implements and occasionally for interior finish.

White ash grows in the eastern and east central states. The wood is light brown in color and very straight in grain. It is heavy, strong, elastic and hard; also it warps but little. White ash is used for interior finish, farm implements, carriages, oars and baskets.

Oregon ash grows on the north Pacific Coast. The wood is brown and the grain coarse and straight. It is medium heavy, medium strong, medium elastic, and medium hard. It is used for furniture, vehicles and sometimes for interior finish.

Black ash grows in the New England states and in the region of the Great Lakes and does best in moist places. The wood is dark brown in color and straight in grain, except a few pieces which have burls, causing them to be valuable as veneers. It is medium heavy, strong, medium elastic, and quite hard. This wood is used for interior finish, cabinetwork, fencing, cooperage, and skis. It is known for its flexibility.

Cork elm, also called rock elm, hickory elm, white elm and cliff elm, grows south of the Great Lakes. The wood is light brown or red in color and the grain is interlaced. It is heavy, very strong, elastic, and hard. This wood is probably the best kind of elm and is used for heavy framing and farm implements.

American elm, also called white elm, and water elm, grows throughout the central and eastern parts of the United States. The wood is

COMMON BUILDING MATERIALS

light brown in color and the grain is interlaced. It is quite heavy, strong, medium elastic, and medium hard. The wood is used for flooring and cooperage. The tree itself is a favorite ornamental shade tree.

Wild black cherry grows throughout the eastern and central part of the United States. The wood is light brown or red in color and the grain is very close and fine. It is medium heavy, medium strong, medium elastic and medium hard. It is used for cabinetwork and interior finish.

Black walnut grows in the east central part of the United States and especially in Tennessee. The wood is chocolate brown in color except the sapwood which is very much lighter. It is medium heavy, strong, elastic and hard. It is used for cabinetwork and interior finish, often being applied as a veneer. Formerly the wood was used in a prodigal manner for furniture and interior trim but has now become so scarce as to be highly valuable, in fact, the most valuable domestic wood of the United States. By many it is considered to be more handsome than mahogany.

Butternut or white walnut grows in the east central part of the United States. The wood is light brown in color and fairly straight grained. It is light in weight, quite weak, medium elastic and soft. It is used for cabinetwork and interior finish.

Beech grows throughout the eastern states. The wood is reddish in color and quite variable. It is heavy, very strong, elastic and

hard. It is used for furniture, implements and flooring.

Hard maple, also called sugar maple and rock maple, grows in the eastern part of the United States. The wood is light brown to red in color and the grain is crooked and fine. It is heavy, very strong, very elastic, and very hard. It is used for furniture, carved articles, implements, and piano actions. Birds-eye maple and curly maple, once very popular, are accidental varieties of hard maple.

Soft maple, also called white maple, and silver maple, grows in the eastern part of the United States. The wood is brown in color and the grain is twisted and fine. It is medium heavy, very strong, very elastic and hard. It is used for flooring, furniture and woodenware.

Oregon maple grows on the Pacific Coast. It is dark brown and red in color and close in grain. The wood is light in weight, medium strong, medium elastic and medium hard. It is used for interior finish, flooring, furniture and tools. In its native region it is a very valuable wood.

Birch grows in the south and the east. There are many varieties not usually distinguished from one another in commerce. The wood is from light brown to dark brown in color, and the grain is close and sometimes satin-like. It is heavy, very strong, very elastic and hard. It is used for woodenware, furniture and ship-building.

Chestnut grows especially in the eastern states. It is reddish brown in color and straight in grain. The wood is light in weight, medium

strong, medium elastic, and medium hard. It is used for interior finish, fence posts and railway ties.

Poplar grows especially in eastern states. It is called yellow poplar, white wood, or tulip tree, and does not belong to the poplar family proper. The wood is a greenish or yellowish brown in color and straight in grain. It is light, medium strong, elastic and soft. This wood is used for general framing, furniture, interior finish, vehicles and pumps. Incidentally it is now being substituted for white pine which is very expensive.

Willow or black willow grows in wet places throughout the eastern part of the United States. In color it is light reddish brown. The wood is light in weight, weak, very brittle and soft. It is used for weather boarding, water wheels and baskets. It is also used to make charcoal.

Basswood or linden grows in the east central states. In color it is very light brown to cream. The wood is light in weight, weak, medium elastic and soft. It is used for picture moulding, paper pulp and woodenware.

Of the soft woods common in the United States and used for structural purposes the following are described in the approximate order of their hardness:

Red cedar grows in the eastern part of the United States and is best along the coast of the Gulf of Mexico. This is the fragrant red cedar which is dull red in color except the sapwood which is white. It is especially fine grained and easily worked. This wood is very light in weight,

DOMESTIC ARCHITECTURE

medium strong, brittle and medium hard. It is used for linen chests, pencils and interior finish.

Port Orford cedar, also called Lawson cypress and Oregon cedar, grows on the coast of Oregon. It is pinkish brown in color and straight in grain. The wood is light in weight, strong, elastic and soft. It is used for interior finish, shipbuilding and very extensively for matches.

Western red cedar grows on the coast of Washington. It is dull brown or red in color, and is coarse and straight in grain. It is very light in weight, medium strong, elastic and soft. This wood is used for interior finish, cabinet-work and shingles.

White cedar grows along the Atlantic Coast in swampy ground. It is pink to brown in color and is straight in grain. The wood is very light in weight, weak, brittle and soft. It is used for shingles, posts, railway ties, cooperage and boats.

Yellow pine grows in various places throughout the country. On the south Atlantic Coast long-leaf pine is common and back from the coast short-leaf pine is very abundant. Pitch pine grows in the eastern states. Loblolly pine grows in the same regions as the Georgia or long-leaf pine. Slash pine grows in Mississippi, Alabama and Florida. Norway pine grows in Wisconsin, Michigan and Minnesota. Western yellow pine grows in the Rocky Mountain region and on the Pacific Coast. All of these pines are yellow, orange and red in color, and straight in grain. They are rather heavy, strong, elastic and medium hard. They are used for heavy fram-

ing, shipbuilding, railway ties, interior finish and flooring.

Douglas fir, also called Oregon pine, red fir and Douglas spruce, grows in the far western states. It is yellow to light red in color and very straight and coarse in grain. The wood is medium in weight, strong, very elastic, and medium hard. It is used for heavy construction and interior finish, being the best general purpose wood on the Pacific Coast.

Spruce, like hard pine, is of many varieties. White spruce grows in the northern part of the United States. Red spruce grows in the mountainous regions of the East. Black spruce grows in the northeastern states. Engelmann's spruce grows in the Rocky Mountains. Tide-land or Sitka spruce grows on the Pacific coast. The wood is light in color and straight in grain. It is light in weight, medium strong, elastic and soft. The various species of this wood are used for general constructive purposes.

Hemlock grows in the northeastern states. The wood is reddish brown in color and crooked in grain. It is light in weight, medium strong, medium elastic and soft. This wood makes a cheap lumber used for joists, rafters and board walks.

Western or black hemlock grows on the Pacific Coast, especially in Washington and Oregon. It is light brown in color, and straight in grain. It is light in weight, strong, elastic and rather hard. This wood is used for framing.

White pine grows chiefly in the region of the Great Lakes. It is from light brown to cream in

DOMESTIC ARCHITECTURE

color and very straight in grain. The wood is very light in weight, medium strong, medium elastic and soft. It is used for doors, window sash, cabinetwork, and other interior finish. This wood is especially valuable on account of its fine qualities, being easy to work and almost devoid of shrinkage tendency. It is becoming very scarce and consequently high in price.

Western white pine grows in Washington and Idaho at great elevations. It is light brown or red in color and straight in grain. This wood is very light in weight, medium strong, elastic and soft. It is used for interior finish and framing. Western white pine resembles the eastern white pine but lacks the finer qualities.

Sugar pine grows in the Sierra Nevada Mountains. It is practically the same as western white pine.

Redwood (*Sequoia*) grows in California and southern Oregon. It is red in color and straight in grain. The wood is light in weight, weak, brittle and soft. It is used for almost everything in California and has the peculiar quality of burning with great difficulty. Also it does not shrink, warp or rot easily. One species of the redwood is the "Big Tree," occurring in ten groves in southern California.

Of the imported woods used for finish and furniture the most important are mahogany, Circassian walnut, French burl, satinwood, ebony and rosewood.

Mahogany comes from the West Indies, Central America and West Africa. It is red in color and turns dark red with age. The grain

is crooked. This wood is harder than hickory or oak. Usually mahogany is used as a veneer over a pine core and the pieces are selected with great care to match. There is also a white mahogany imported from the west coast of Mexico used for finish and furniture. It is creamy white in color. In the Florida Keys of the United States mahogany is a native tree. A Philippine mahogany also is now being brought to our eastern markets.

Circassian walnut comes from the region of the Black Sea. It is a rich brown in color and very crooked in grain. In veneered work the pieces are matched similarly to marble slabs, often forming a fantastic design. This is perhaps the most elegant and costly wood in general use for finishing the interiors of expensive rooms.

French burl comes from Persia. It is a walnut with a burl or knot that forms on the tree when young. The wood is dark in color and curly in grain.

Satinwood comes from the West Indies. It is light in color and satiny in lustre, also finely mottled in grain. The wood is used for veneering small surfaces.

Rosewood comes from Brazil, Jamaica and Honduras. It is a dark red wood with black lines through it, used both as a solid material and as a veneer. On account of its resinous nature it is difficult to work.

Ebony grows in India and Ceylon, also in the West Indies. In the far east logs are several feet in diameter, while in the Indies the trunks are rarely over four inches. Only the heart-

DOMESTIC ARCHITECTURE

wood of the large trees is black. The wood is very hard and will take a high polish. It is used for cabinetwork, inlaying and for various turned and carved articles.

Steel and Iron.—Steel and iron are used very extensively in building, but very moderately in house construction. Steel is made from iron, and possesses the property of taking a temper. In some steels in which the carbon content is low, tempering is not in evidence. Iron for building materials is either cast or wrought. By cast iron is meant iron which has been heated to a molten state and poured into moulds, where it is allowed to congeal, thereby forming structural members such as posts. By wrought iron is meant iron that has been hammered or rolled into shape. The chief building materials made of steel and iron are classified under the head of builders' hardware, which may be either common or finish hardware. Articles included under the head of common hardware are cast-iron posts and plates, steel I-beams, angles, channels, etc., and joist hangers, bolts, nails, strap hinges and screws. Hardware used in the finish of rooms (e. g., door knobs, drawer pulls, etc.) is called finishing hardware.

Sheet metal is used extensively in construction. However, it is not always of iron or steel, but may be of tin, copper or zinc. Perhaps galvanized iron in sheets is the most serviceable of these materials. Gutters, down-spouts and flashing are made of sheet metal.

Sheathing Paper and Deadening Quilts.—A very useful building material is paper used to

protect a frame building from penetrating winds. Building paper is a paper saturated with tar, resin or other waterproof material, and is applied to the sheathing or rough boarding of the house, both on the walls and on the roof, over which shingles or weather boards are nailed. Deaden-ing quilt is made in a number of ways, usually consisting of two layers of paper between which has been stitched a material of straw, hair or seaweed, and is used under floors and in walls to deaden sounds and stop leakage of cold or warm air.

Many other materials of various kinds are in the market; some are fire-resisting materials, such as asbestos; some are damp-resisting materials, and some are insulating materials.

An exceptionally good insulating material is mineral wool. It is used between joists, studs, and rafters of frame buildings. By filling the space between the rafters with this material attic rooms may be made much warmer in winter and cooler in summer.

SKETCH PROBLEMS

(1) Make a sketch of an ashlar wall in which the stones are laid up in regular plumb bond but with two sizes of stones. Indicate that the face of all stones is bushhammered with margin.

(2) Design a simple brick diaper pattern to be used as a frieze below the main cornice of a brick house of modern English type.

(3) Make a diagram showing method of quarter sawing a log.

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CHAPTER VIII. FINISH BUILDING MATERIALS

SCOPE.—Many building materials are used not only as common but also as finish materials. Marble is used for wainscotings, floors, mantels and other interior features. Brick is used in the interior as is tile and terra cotta. Wood is used extensively in all parts of the building. Plaster is used both on the exterior and interior, more extensively on the interior. Paints and stains are used on all parts of the house, as is glass, which actually becomes a part of the wall. Hardware is also essential. All these materials are considered to be finish building materials, when used on the inside.

In regard to heating, plumbing and lighting fixtures, they are parts of specially installed appliances for certain purposes rather than finish materials.

Materials used to make Plaster, Mortar and Concrete.—The chief materials used to make lime and cement plaster are common lime, Portland cement, sand, and water. Other materials are also used in practice.

Common lime, or so-called quicklime is made by the calcination of limestone. The operation is performed by means of kilns of various types, depending upon the locality where the limestone is quarried. Calcination consists in the decomposition of the calcium carbonate of the limestone into calcium oxide (quicklime) and carbon dioxide gas. The latter is expelled along with any moisture which may be present.

Lime to be of good quality should be free from cinders and other impurities. It should also be in lumps rather than in dust and should slake readily in water. Slaking lime consists of the chemical union of calcium oxide and water to form calcium hydroxide. When the mixture of slaked lime and water is further mixed with sand, mortar is made which when dry becomes very hard. The main chemical process in the hardening of lime mortar is its absorption from the air of carbonic acid, the same material which was driven off in the calcination process by means of heat. Therefore the substance of cement mortar is similar to the original limestone from which the lime was derived. Lime already hydrated by manufacturers may be purchased, thereby saving the trouble and expense of slaking lime on the building site. Such lime is usually more pure than ordinary unslaked lime.

The cement used in ordinary cement plaster and concrete work is Portland cement. Portland cement is produced by burning a natural or artificial rock mixture containing approximately three parts of lime carbonate and one part of silica, alumina and iron oxide, the clinkers resulting being pulverized into a powder or dust which is the cement. The finished product consists of about two parts of lime and one part of silica, alumina and iron oxide. Cement mortar and concrete will set either in the air or under water. Lime mortar will set only when exposed to the air.

Sand of the best quality for plastering work must be sharp and clean; that is, each grain

must be angular and free from foreign substances such as silt. River sand and sea sand are used in plastering when sharp, excavated sand is not available. The color of sand is of some importance, white being the best. In concrete work, clean gravel, every stone of which will pass through an inch ring, or crushed rock of approximately the same size, is used. In pebble dash plaster work very small pebbles of the required color are used.

Finish Woods.—Woods are prepared for use in finishing work by selecting pieces and sawing them into stock sizes and shapes. By using this stock material for baseboards, chair rails, picture moulds, and trim in general, quite a saving is accomplished. In the better class of work, where more individuality and character in the design of the interior woodwork is desired, the various pieces of wood used should be made to order according to drawings. However, even in the making of these special pieces, certain stock sizes of material may be used from which to cut the member desired. The wood trim of a room may be of practically any wood, depending upon circumstances, but the hard woods are usually employed. When cheap woods are used, it does not pay to attempt to preserve the finishing qualities of the wood, as grain and color, because all surfaces are better covered over with paint, enamel or stain.

Perhaps the most important part of interior wood finish is the floor. Flooring is made in strips from three-eighths to three-fourths of an inch thick, one edge having a tongue and the

other edge a groove, so that the boards may fit together very closely. The best flooring is made of quarter-sawed oak, and should be in narrow, thin strips, on account of the tendency of oak to warp and swell. For dance halls, billiard rooms, and quite often for ordinary rooms in the house, maple flooring is very satisfactory, on account of its durability and its whiteness. Common floors are made of yellow pine, spruce, birch, white pine and fir, which in all cases should be edge-grained or quarter-sawed. Flooring is held in place by means of secret nailing; that is, nails are driven through the tongue of the board and the next strip of flooring fitted on over the tongue so as to conceal the nail head.

Only high-class, kiln-dried finishing lumber should be used for interior woodwork, including doors, windows, shutters, wainscotings, bases, chair rails, picture mouldings, panels, wooden beams, cornices, columns, stairs, posts, railings and built-in fixtures.

Finish Hardware.—Finish hardware includes door knobs, escutcheons, locks, butts, hinges, window fasteners, and all such articles of metal used in finishing the interior of a house. In common practice this hardware is selected from stock rather than made to order. A large number of patterns are manufactured, from which an appropriate set of finish hardware may be selected. The mechanism of locks and equally important parts should be constructed of wrought steel, and should be of such quality as will give permanent wear and satisfaction. In buying

hardware it is necessary to depend upon the dealer or the manufacturer for the quality of the goods, since it is impossible for the average builder to definitely determine whether or not hardware is of the best material and workmanship. For instance, articles of iron, such as andirons, may be of cast steel with small pits upon the surface. The whole may be plated over with a coat of brass, giving the appearance of hand-hammered brass, which would be very expensive. As a matter of truth, such andirons are cheap, but really make a good appearance. Hardware which is heavy may usually be assumed to be of reliable material, so that a very good test of hardware is the weight. Manufacturers have so many secret and patented methods that it is not worth while for the layman to endeavor to learn all of the processes.

The metals chiefly used for finish hardware are iron, brass and bronze. Occasionally glass, porcelain and wood are used for certain parts. Metals may be wrought, cast or pressed into shape from sheets. Iron is finished by simply cleaning it with a file or brush, by covering the surface with a black varnish called Japan finish, by heating and dipping it into a composition of oil and an alloy of copper or bronze called lacquer finish, and by electroplating with nickel. Still another finish for iron is called Bower-Barf, in which the surface is changed into magnetic oxide or iron, black in color and proof against rust. This finish is not expensive, and is a very serviceable kind of hardware.

Brass is an alloy of copper and zinc, of a bright

DOMESTIC ARCHITECTURE

yellow color, and capable of a very high polish. However, brass tarnishes very easily, and is ordinarily protected by a coat of shellac. Brass may be wrought, cast or plated. Cast brass is the best for general purposes.

Bronze is a composition of copper and tin, and is a very useful metal for casting delicate patterns. The finishes for solid or plated bronze hardware vary to a great extent in appearance, and also in cost. The colors may be light, dark or spotted.

Glass is used only for door knobs and drawer pulls, usually in connection with white or light colored woodwork. Porcelain and wood are used in the same way.

Paint, Enamel, Varnish and Stain.—Paint is a prepared liquid applied to materials for the protection or ornamentation of them. Paint commonly consists of linseed oil, either raw or boiled, called a vehicle; a metallic oxide, such as white lead or zinc oxide, called a base; and turpentine or alcohol, called a solvent. Thus any ordinary paint contains a vehicle, a base and a solvent with usually some other material to cause the paint to dry readily called a dryer, and coloring matter, called pigment. Paints vary in composition according to the use for which they are made, some paints being for exterior work on wood, some for interior work on wood, and some for covering metal surfaces. For the latter a base of red lead is commonly used. Enamel is a paint in which varnish has been used as a vehicle. It is usually applied over common paint which has been rubbed with

sandpaper, or over a flat interior paint which already has a dull surface. Enamel may be either of a dull or glossy finish. It is usually prepared by a manufacturer and sold ready for application. Enamel is made thin by the use of alcohol.

Varnish consists either of a resin dissolved in a volatile oil, or of a resin mixed with linseed oil and dissolved by the use of turpentine or benzine. Shellac is a type of the former, while oil varnish is a type of the latter. The gums used in varnishes are of a great many kinds, including amber, mastic, and lac. In the application of varnish, the wood is cleaned and a coat of paste rubbed into the grain with a stiff brush, after which the surface is rubbed with burlap and the varnish put on with a brush. Whenever dry, other coats may be applied, usually, however, not until the previous coat has been rubbed to a dull finish with sandpaper or mineral wool. Flat tones are acquired by rubbing the surface with pumice stone and water.

Wood stains consist chiefly of alcohol and coloring matter. Many of them are patented. They are applied to the clean surface of wood, and rubbed dry with burlap or a flannel cloth. On top of wood stain it is necessary only to apply a coat of shellac or a coat of wax. Wood dyes may be obtained in practically any color and shade, most of which are reliable for interior work. However, there is a tendency for some colors to fade in the bright light.

Tile, Brick and Terra Cotta for Facing.— Tiles are made in a great variety of designs and

DOMESTIC ARCHITECTURE

colors for use in floors, hearths, wainscotings, walls and other facings. They are made similarly to other clay products, but almost invariably have a glazed surface. Usually dull surfaces are more pleasing. Quite often the design of a tile is worked out in a number of colors. Perhaps the best tile work is in fireplaces, where tiles of individual character, probably made by hand, are incorporated in the design of the fixture. Floor tiles are sometimes a foot square, and sometimes very small indeed. They may be oblong, hexagonal or octagonal in shape or even irregular, but must be laid to fit closely, joints being filled with cement plaster. Wall tile are usually rather small, and require a substantial backing.

Brick and terra cotta are of finer texture and design for interior work in order to produce pleasing effects. Bricks employed in fireplace construction may be laid up in practically any pattern, while terra cotta is usually made according to a certain design to suit the case in hand. In the use of tile, brick and terra cotta for interior work, it is very necessary that the selection be carefully made in order to avoid introducing a character or effect foreign to the environment. It may be mentioned that stone is also used for interior work. Many rustic or bungalow fireplaces are constructed of field stone or rubble.

Glass.—Glass as used for clear window panes is of two kinds, plate and cylindrical or sheet glass, each having many grades. Plate glass is made by pouring the molten glass on large

tables, and rolling the mass to a smooth and even surface, after which it is thoroughly polished. Plate glass is about one-quarter of an inch thick, and may be obtained in very large pieces, either flat or curved. On account of the great amount of breakage in the manufacture of plate glass, and on account of numerous defects which cause the glass to be recast, the price is high.

Since small pieces of plate glass are more easily obtained than large pieces, the cost of small pieces per square foot of area is very much less than that of large pieces of the same kind of glass. Plate glass, when properly manufactured, is absolutely clear and devoid of defects. It should be used in all buildings which have a general quality sufficient to warrant the expense.

Sheet or cylindrical glass is made by blowing the hot mass into cylinders which while still hot are cut and laid out flat. This glass always has defects such as air bubbles, and waves. It is made in a number of qualities, the best being called AA double strength, and the cheapest being called B single strength. Sheet glass set in window sash and doors may be secured at any planing mill. These are called regular stock, and are of only mediocre quality. The design of such a sash or door lacks character, making the article itself unsuited for high-class residence work.

Leaded glass is made for the most part by experts who fit together small pieces of glass and secure them at the edges by means of lead strips with flanges. The design of leaded glass

may be very elaborate in every respect, or may be quite simple. Examples of very wonderful leaded art glass may be seen in the cathedrals of Europe, and, of more recent construction, in some of the residences and churches of America. Most of the art glass is leaded glass, although certain effects using colored glass have been attained by other means.

Translucent glass is quite often desirable where transparency is objectionable; thus white glass is used in doors and windows to quite a degree. White glass is called "crystal," "crimped," and other names in the trade. A fireproof glass has been invented which will not break under extreme heat, being cast with a network of fine wire throughout its length and breadth. This glass is called wire glass, and is used in places which may at some time be subjected to intense heat caused by a nearby conflagration. Prism glass is a unique kind of glass in which the surface has been ground into a large number of prisms of one shape or another, which tend to collect light and distribute it at a certain place in the interior according to the conditions involved. Prism glass is made from plate glass, and after being ground is highly polished. It is used in the upper part of store fronts and elsewhere to throw light into remote parts.

SKETCH PROBLEMS

(1) Show by a diagram the form of a piece of oak flooring and how it is held in place over a common floor.

(2) Show by sketches a pattern for a tile floor in a bath, a pattern for a tile wainscot in a reception hall and a pattern for a tile hearth before an open fireplace.

(3) Design a leaded glass window to be used as one of a series of five in the dining room of a typical bungalow. The sash is hinged at the side and is 24" x 52" inside the frame. Make drawing at the scale of $1\frac{1}{2}" = 1'-0"$.

REFERENCES

Kidder.—Building Construction and Superintendence. Parts I and II.

Noyes.—Wood and Forest.

Kellogg.—Lumber and its Uses.

CHAPTER IX. HOUSE CONSTRUCTION

KINDS.—In general terms, buildings are said to be either of masonry or carpentry construction. However, in practically all cases, both masonry and carpentry construction are employed. To the casual observer, a building that has walls of brick, stone or terra cotta, and sometimes of plaster, is a building of masonry, and the building that has walls of shingles, siding or other wood material is a building of carpentry, or a frame building. Houses constructed of masonry, especially brick and stone, are more durable than frame buildings, but of course cost considerably more. The chief condition against which it is well to guard in the erection of a brick building is dampness. To avoid this condition, it is necessary to keep the inside plastered surface away from the structural wall of the building by nailing the lathe to furring strips which are securely fastened to the brick wall itself. Furring strips are held to the brick wall by driving nails into the mortar between bricks, or into wooden bricks set into the wall for the purpose. A type of house used to some extent in the more severe regions of the United States is the brick veneer house, which is constructed almost exactly like a frame house, but is enclosed with a four-inch brick wall, giving the appearance of a brick house. This type of building is very comfortable in all seasons of the year on account of its insulating character. Still another type of masonry building is the one constructed of hollow bricks or hollow tile for outside walls.

Here, since the hollow materials provide an air space within the wall, it is not necessary to furr out for lathe and plaster, the plaster being applied directly to the inside wall surface. The exterior of many such buildings is also plastered with a cement mixture.

Houses of frame construction are erected according to two chief methods. One is called balloon framing, and the other is called braced or full framing, which is the old-fashioned method. In the latter method, all timbers, including sills, posts, girders, and plates are made of heavy timbers, and are mortised and pinned together, making a very substantial frame. Some of the old houses built of white oak, following this method, are almost indestructible. At the present time the balloon frame is very common. The parts are spiked together and braced, but no members are mortised and tenoned. A combination of the two types of framing is not only economical but very durable. In it the sills, posts, girders and braces are mortised and pinned, but the common studding is only notched and spiked, as are the rafters.

Method of Procedure.—In the erection of a building, plans and specifications consisting of accurate drawings of all parts and a description thereof are followed in every respect. In most cases drawings and specifications are prepared by an architect, but sometimes by a contractor, builder or carpenter. Occasionally a house is erected without preliminary design, or perhaps with only a mental picture of the house as it is to be. Undoubtedly the best

DOMESTIC ARCHITECTURE

results are obtained when fully developed drawings and specifications are in the hands of the builder. A specification describes the work indicated on the drawings in the order in which the various operations will require attention. First comes the staking out of the building, then excavation, grading and drainage, masonry work, wood framing, outside finish, lathing and plastering, inside finish, painting and glazing, installation of hardware, and house decoration. Meanwhile, after the building has been enclosed the heating and ventilation, lighting and plumbing are installed, with the exception of the fixtures, which are put in at about the same time as the finish hardware.

Staking out the Building.—After the placing of the building on the lot has been definitely determined, the exact location of each corner is indicated by driving small stakes into the ground with a nail driven into the top of each stake marking the intersection of the building lines. Outside of the stakes, perhaps six feet on each side, batter boards are set up on low stakes, and the actual lines marking the building lines are extended to the board and fastened permanently so that when the stakes at the corners of the building are removed with the excavation of earth, the lines of the building will still be in evidence, from which the foundation walls will be accurately constructed. Thus the batter boards are safe out of the way of excavated earth, and the strings or lines fastened to them mark the exact location of the building until the foundation is completed.

From that time the foundation itself is sufficient guide for the superstructure. In order to have the first floor level at the proper and premeditated height, it is necessary to establish a bench mark or known grade relative to the street grade. In this way the first floor level may be made the exact number of feet and inches required above the elevation of the sidewalk.

Excavation and Grading.—In excavation, the earth should be removed only as far down as the under side of the basement floor, and a foot or two outside of the foundation wall. During excavation, usually done with scrapers, it is more economical to distribute the excavated earth upon the site or elsewhere, in such places as it is to occupy permanently; otherwise a re-handling of all excavated earth is necessary, which is an additional expense. Moreover, by this method of handling of excavated earth in one operation, inconvenient mounds of earth around the building are avoided. In excavation, the top of the soil should be preserved to be later distributed over the surface of the yard to provide a fertile soil for the growth of grass, shrubs and plants, at which time the grading, levelling and smoothing down of the soil will also be taken care of. (See Plate 42, Fig. I.)

Masonry.—At this time it is necessary to ascertain the condition of the soil on which the foundations of the building are to be erected. A solid surface of clay, gravel or rock is essential. Mud, silt, filled-in soil and quicksand are not reliable, so that in case a better building surface is required, further excavation, the driving

DOMESTIC ARCHITECTURE

of wooden piles or the setting of concrete piers may be necessary. Sometimes other remedies for such conditions are employed. Before the foundation wall itself is put in place, a small trench wherever walls are to occur is further excavated below the earth floor of the building, in which will be placed the footing. Footings are of brick, stone or concrete, and for houses are ordinarily sixteen inches wide, eight inches deep and as long as is the wall which rests on top. Assuming that a footing is to be of concrete, a mixture consisting perhaps of one part cement, three parts sand and five parts gravel, properly prepared, is poured into the excavated trench and allowed to become set and hard. In most excavations the walls of the footing trench will maintain themselves sufficiently well so as to necessitate no further walling of the trench by means of planks. Upon this footing, after a few days, may be erected a wooden form in which a concrete mixture of the same proportions as the footings is to be poured, forming a solid wall perhaps eight inches thick and eight feet high. When this concrete is hard the plank forms are removed by the carpenter who erected them, and the foundation wall is established. Frames for doors and windows in foundation walls should have been set in place before the concrete was poured, so that they would be securely imbedded in the monolithic mass. At this stage of the building operations, the rough framing may be commenced, but before the space outside of the basement wall is filled, and quite often even before

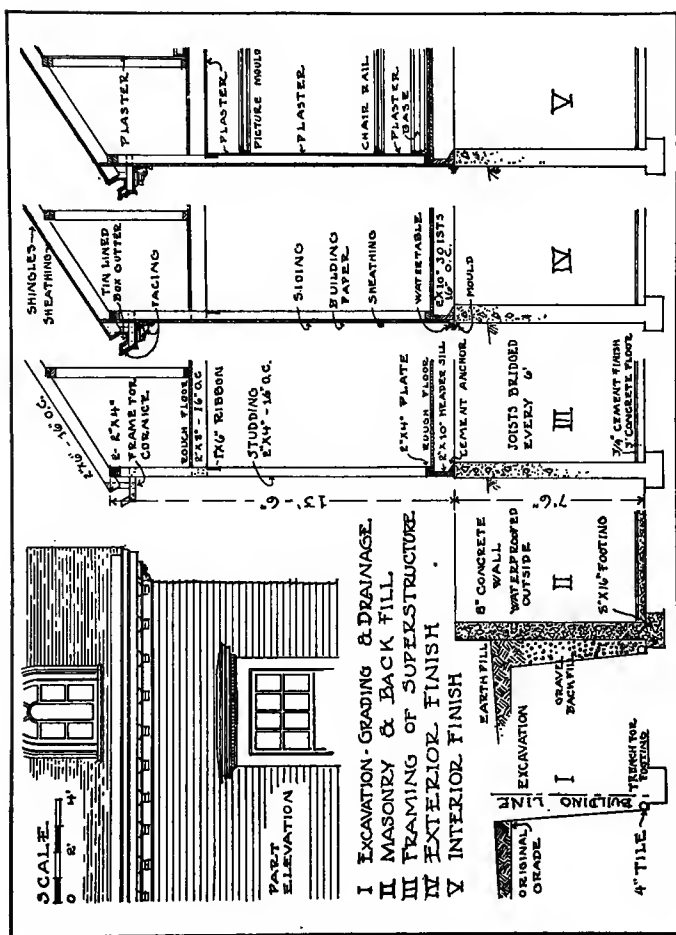


Plate 42
 DETAILS SHOWING PROGRESSION OF CONSTRUCTION

DOMESTIC ARCHITECTURE

the wall itself is built, it is important to lay a four-inch drain tile at the bottom of the excavation on the outside of the wall to carry off seepage water. Tile should also be laid where necessary inside of the basement wall and connected with the main drain pipe, to prevent the future basement floor from becoming wet. Also before backfilling, it is important to make the concrete wall waterproof either with a coat or two of hot tar put on with a mop, or with a coat or two of waterproof concrete paint, applied with a brush. This water-proofing should be on the outside of the wall, but may also be on the inside. In the better class of work the first three or four feet of backfilling consists of cheap gravel or crushed rock, so that surface water will have a free flow to the drain tile which is to carry it away. The upper part of the backfilling may be the earth removed by excavation, except the top soil. (See Plate 42, Fig. II.)

Basement floors are usually constructed of concrete three inches thick, but with a wearing surface three-fourths of an inch thick consisting of one part of cement and two parts of sand. This concrete floor is laid directly upon the earth floor at the upper line of the footings, but in case a fill is necessary before laying this floor, gravel or cinders may be used. Floor drains opening into the tile drains already in place should be provided at convenient places, according to the arrangement of the future basement rooms.

No matter what type of building is to be erected, all of the masonry work is constructed as rapidly as possible, including footings, founda-

tions, walls, chimneys, ash pits, fireplaces, and sometimes porch floors and other floors, and rarely even roofs. Walls of masonry are usually eight, twelve or sixteen inches thick, depending upon the height of the dwelling and the material used. Concrete need not be so thick as brick and stone walls. Quite often a two-story brick house has twelve-inch walls in the basement and first story, and eight-inch walls in the second story. Frame cottages and often two-story houses may have eight inch concrete basement walls. Small brick houses may have eight-inch walls throughout. Usually only exterior walls are of masonry. In chimney construction a substantial footing should always be provided and the chimney carried from basement floor through attic space in as straight a line as possible. A brick chimney should never be bracketed from a wall in the first story and carried through the roof, because the weight of the chimney itself invariably cracks plaster and wall paper, and is, moreover, a dangerous structure. Chimneys, and in fact all brickwork laid up subject to outside weather conditions, should have cement mortar. Brickwork protected, that is, on the inside of the building, may have lime plaster. Four-inch brick walls are used to enclose ash pits and to separate flues. Each fireplace, heater and stove in the building should have a flue of its own, combined, perhaps, into one chimney or stack. Flues should be lined either with *terra cotta tile* or a smooth coat of cement plaster. Brick and tile hearths for fireplaces should be supported by masonry from

DOMESTIC ARCHITECTURE

beneath whenever possible, rather than supported by wood floor construction. Second-story fireplaces should be supported by masonry carried the full width through the first story. Usually it is not possible to support the hearth of a second-story fireplace except by means of the wood joists. All parts of the building including porch steps should be securely set upon foundations of masonry to avoid settling, and should moreover be scientifically grounded in order to prevent one part of the building from greater settling than another, because in all cases a building must settle a fraction of an inch.

Wood Framing.—Assuming the construction of a story and a half dwelling with a foundation of masonry and superstructure of wood, the next operation after a concrete basement wall has been completed is the erection of a wood frame. Incidentally, in all cases the masonry wall should extend to the bottom of the first floor joists rather than to the grade only; otherwise the frame superstructure must start at the grade and the first floor joists be supported by a wood plate. Thus the upper part of the basement wall is of frame and, unless plastered on the inside, allows the wind to blow into the cellar making the house difficult to heat.

Around the outside edge of the concrete wall enclosing the basement a continuous 2" x 10" timber is set, perfectly level, and 2" x 10" joists are laid from wall to wall, or wall to girder, placed usually sixteen inches apart to receive the rough floor. These joists are held in place

by spiking through the edge timber into the ends of the joists. A very good method of anchoring this floor frame in place is by pouring grout, a soft mixture of cement, sand and water, on top of the concrete wall between the timbers, thereby firmly imbedding them, and also stopping all cracks which would otherwise admit air. This method of framing, although not in common use, probably excels the solid or box sill construction. A rough floor having been laid over the entire first floor area, the house as far as constructed is a large platform with such openings as will later be required for chimneys, hearths, lifts, vents, ducts and stairways, framed securely.

The next operation consists in laying probably a 2" x 4" plate around the entire wall of the building, and also on the line of all inside partitions upon which are to be erected studding or upright 2" x 4" pieces. Studding are usually set sixteen inches apart or on centres, spiked at the bottom to the 2" x 4" plate, and receiving on top another continuous plate made of two 2" x 4" timbers lapped at the corners and break jointed at other places, where it is necessary to splice the continuous parts. Studding as well as floor joists should have braces or bridging inserted between them, in order to insure rigidity. The height of this double plate varies according to the use of the wall or partition. Its purpose is to provide a bearing for second-floor joists and also rafters. In outside walls, therefore, the plate must come at the proper height according to the design of the building to prop-

erly provide a seat for the end of the rafters. In the assumed story and a half house the plate would probably be about four feet above the second-floor joists, depending upon the pitch of the roof and the number and location of rooms in the half story. Usually the space under the low part of the roof is either used for closets and store rooms or is not used at all. In case, then, the double plate or roof plate is a distance above the second-floor joists, a bearing must be provided for the ends of these joists. This is accomplished by inserting into the studding on the inside of the wall a 1" x 6" ribbon or board and nailing it in place, upon which the joists rest. However, it is necessary to nail the joists to the uprights as well as allowing them to bear upon this board. (See Plate 42, Fig. III.)

Rafters are usually made of 2" x 6" pieces placed twenty-four inches on centres, unless the rafters are to receive lathe and plaster, in which case they should be sixteen inches on centres in order to give more nailings for the lathe and consequently more stiffness to the plastered wall. The reason that studding and rafters, as well as floor joists are placed either twenty-four inches or sixteen inches on centres is that wood lathe are four feet long, thereby allowing the lathe to cover either two or three spaces between frame timbers. Rafters are, of course, used over the entire roof, including dormers and other projecting parts. All angles in the roof, especially those forming valleys, should have extra strong boards the length of the angle, against which rafters cut with diagonal ends are

spiked. Hips and ridges need have only light boards against which to spike the rafter ends because the stress is in compression and the parts are already practically rigid. In framing rafters and all other wood members around chimneys, it is necessary to keep the woodwork two inches at least away from the brick, for two reasons: one is to allow the chimney to settle independently of the woodwork; and the other is to guard against fire, since bricks may become so heated as to inflame dry timbers.

Over all exterior walls and the roof surface, a rough boarding is nailed in place. Ordinarily cheap matched material is employed, but common boards four, six or eight inches wide may be used, allowing two inches between each board instead of laying them close together as would be done in case matched lumber was used. This boarding is called sheathing, and should be nailed to the outside walls diagonally rather than horizontally, to stiffen the entire frame of the building against wind pressure. For the same reason rough or under-flooring may also be laid diagonally. Another advantage in using diagonal rough boarding in all parts of the building is that when finish boarding such as floors and siding are nailed on top, the joints between boards will not run in the same direction, thereby eliminating any chance of cracks between boards coming exactly opposite each other, also providing better nailing facilities.

Door and window openings are not sheathed over, the location of all openings having been determined from the working drawings, and

framed in the studding by using double members on all sides, and in case of wide openings, by trussing members across the top of the opening. In a finished building sheathing is not in evidence, so that it is impossible to tell without close inspection how a building is sheathed. For this reason it is quite often omitted, especially in houses erected for speculative purposes.

On top of sheathing, especially on the walls of the building, standard building paper should be applied, each strip lapping about halfway over the strip below and held in place by means of large-headed tacks or other contrivances. Building paper costs but very little and for its cost gives more insulation to a building than any other part of the structure, so that in climates at all severe it should never be omitted. The paper should be especially well fitted around all openings, under the eaves, and at the base of the wood structure, where it joins the masonry.

The outside walls of a dwelling having been covered with building paper, perhaps only a portion at a time, are ready for the outside finish, which in a brick veneer house would be a four-inch brick wall set an inch or so away from the building paper; or in a frame building of the type assumed, would be shingles laid perhaps with five inches of the shingle to the weather; lap siding, which is the common siding used in the east; rustic of one pattern or another, which is the common siding used in the west; undressed boards lapped in order to prevent leakage; cement plaster on metal lathe, furred out from the building paper; or some other special material.

The roof may be covered with wood shingles laid about four inches to the weather, slate, tile, tin, or patent roofing material.

Exterior Finish.—Included in exterior finish are the finish wall material, window and outside door frames, sash and doors, casings, water tables, eaves, cornices, barge boards, dormers, porches, etc. Door and window frames should be made especially well according to carefully prepared details, to insure against leakage of air and water. Many types are in use, but in the better class of houses the frames are made to order to suit the conditions. Around the outside of such frames flashing of tin or copper should be employed to guard against the seepage of rain water between the frame and other parts of the structure. The detail of the window frame depends especially upon the type of window, since casement, pivoted, double hung, stationary and other types may be used. Around all door and window frames a casing is usually applied in various manners, allowing always at the bottom a sill with a wash on the top surface from which water will readily flow. Under the outside edge of the sill a small groove should be cut, called a drip, which is designed to prevent water from flowing back on the under surface of the member. (See Plate 42, Fig. IV.)

Water tables are belt courses or bands running horizontally, provided for the purpose of conducting water which flows down the side wall of the building away from the parts beneath, especially away from the foundation wall, at which line a water table is usually placed. Water

tables may be made by cutting a small timber in a shape which is much like a window sill, or by curving a siding or shingle surface sharply outward, or by some other device.

The chief exterior member of a building is the cornice. In general, cornices are of two types. One is the box cornice, which is enclosed with a facing of wood members, usually having a metal lined box gutter. The other is the exposed cornice, in which the rafter ends usually show, and a hanging gutter of metal or wood,—usually metal,—is employed. The variations in both types are almost numberless; practically no two buildings have cornices exactly alike. However, similarity of construction in localities is very much in evidence.

Box cornices are constructed by building a rough background for the cornice facing, consisting principally of the rafter end and outlook member, and braces to support the gutter and other parts. When this is set in place according to the design of the cornice, the finish members are applied and fastened in place with finishing nails. In box cornices mouldings are invariably used. The typical cornice for a colonial house is of this type. (See Plate 43.)

Exposed cornices are usually constructed using the actual rafter ends as a base. Sometimes, however, the rafter ends are applied for the purpose of forming the cornice. The space immediately below this type of cornice, including perhaps the cornice itself, is called the eaves. The gutter is hung at the extreme edge of the cornice. Gable ends and dormers are finished

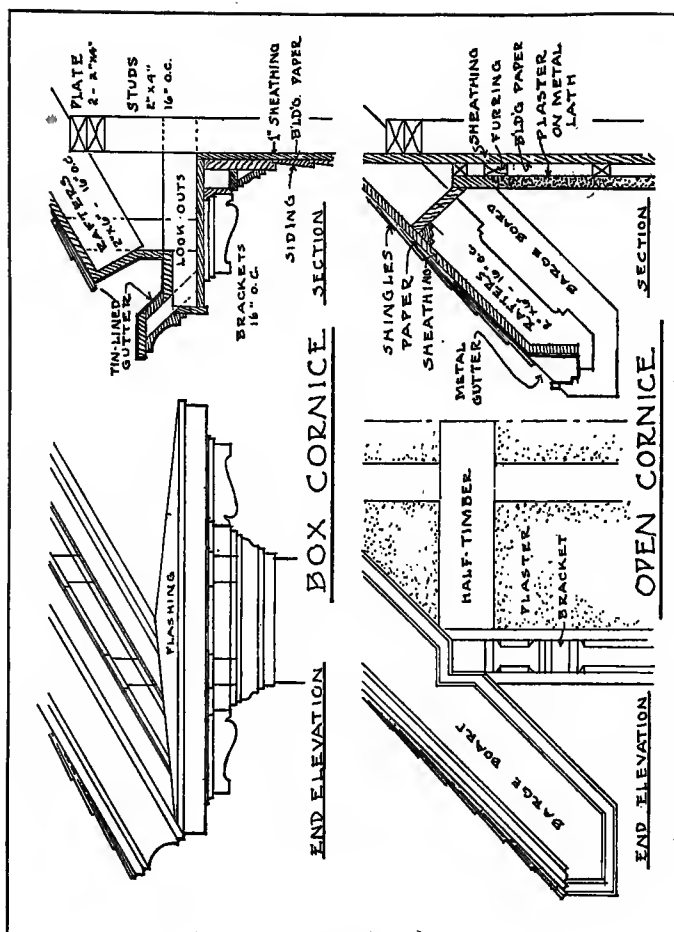


Plate 43
THE TWO MAIN TYPES OF WOOD CORNICES

according to the character of the house. In houses of colonial type, moulded cornices, edgings or crowns are employed, according to the design. In less formal and English houses, other finishes are used, of which the barge board is the most common. A barge board is a plank set a short distance away from the gable or dormer end and forms a facing terminating the roof of the building. Usually a small mould is employed at the top edge for a finish. Barge boards are supported by means of brackets. Elaborations on the barge board, sometimes called a verge board, are used extensively in other than the most simple houses.

Exterior finish is of vital importance in giving style or character to a building. Not only is a good general proportion necessary, but an accurate working out of each large and small part is essential to the greatest success.

SKETCH PROBLEMS

- (1) Draw at the scale of $1'' = 1' 0''$ a concrete foundation wall and specify all things that pertain to it.
- (2) Draw a sectional view of an open cornice.
- (3) Draw a sectional view of a box cornice.
- (4) Make a drawing of a window sill, stool and lower rail of sash to show necessary precautions for keeping out driving rain and snow. The detail may be for any one of the several kinds of windows and should be shown in cross section at large scale.

REFERENCES

- Kidder.—Building Construction and Superintendence.
Parts I and II.
Berg.—Safe Building.
Clark.—Building Superintendence.

CHAPTER X. INTERIOR FINISH

LATHE and Plaster.—After a building is enclosed, that is, when the exterior facing and roof are complete, it is ready for plaster. Plaster is applied to a lathe surface by means of a trowel, the lathe surface being made by nailing wood or metal lathe to the furring strips or to the studing or uprights of a building. Plaster is of two kinds in general, one called lime plaster and the other cement plaster. Lime plaster or mortar is made by mixing unslaked lime, water and sand in certain proportions, and for the first coat of plaster by adding cattle hair in order to make the mass hold together when put in place. For other coats of plaster the hair is omitted. After the first coat has been applied, it is scratched with the point of the trowel to give it a rough surface so that the following coat will adhere. The second or third coat may be finished by rubbing the trowel over it, using a circular motion, forming what is called a sand finish. To obtain a hard, smooth finish, a very thin coat of patent plaster may be applied, which when dry becomes white. The chief ingredient of patent plaster is plaster of Paris. Lime plaster is used only for interior work.

Cement plaster is made by mixing together Portland cement, sand and water in certain proportions, and is used especially for exterior work. The first coat is worked into or between the lathing with a trowel, and is about one-half of an inch thick. While still wet, the surface is scratched as is the first coat of lime mortar.

The second coat of cement plaster is applied with the trowel in a similar manner, and if not considered to be the last coat, receives still a third coat which may either be put on with a trowel or put on by casting very wet plaster against it with the trowel or a paddle. This operation produces what is generally termed rough-cast plaster, or stucco. In case small pebbles are mixed into the plaster used for the final coat, and the whole mixture dashed against the wall with the trowel, the surface produced is called pebble dash. Many different plaster effects may be obtained by the use of various materials.

Plaster is applied to either wood lathe or metal lathe. In ordinary construction the inside walls are lathed with small strips of wood four feet long, about one and one-half inches wide and three-eighths of an inch thick, laid up the thickness of the lathe apart. For extra good interior plaster work and for all exterior plaster work, a lathe made by expanding sheet metal is used as a background for the plaster. Such lathe is called expanded metal lathe, and is made by many manufacturers in different ways. The furring upon which the lathe is nailed is usually made of thin strips of wood an inch or two thick, securely nailed in place upon the wall of frame or masonry behind.

As a means of stopping fire which may get into the walls of a frame building, or as a means of stopping vermin such as rats and mice from running between joists and studding, the spaces between frame timbers may be plastered. This

DOMESTIC ARCHITECTURE

is called back plastering. In rigorous climates, back plastering is often done to make the building warmer by keeping out wind. Here all spaces between outside timbers are back plastered.

In plastering the interior of a house certain precautions should be observed in order to insure a satisfactory result. Lathe should never run through a wood partition from one room to another as a continuous lathed surface, but should turn with the corner of each room in order to avoid cracking of the plaster from settlement after it has become hard. All walls should be plastered from the ceiling to the rough under-floor, including all wall surface, even though a wainscoting or fixture is to be built solidly against a part of the wall. In other words, the space behind built-in-fixtures should be plastered as though the fixtures were not to be erected there. Before the plaster of any room is applied, small strips of wood called grounds should be nailed to the lath in such places where wood finish is to be later applied on top of the plaster. Grounds, therefore, become nailing strips for the wood finish, and also mark a perfectly vertical surface to which the plaster surface is to be accurately brought. In the plastering of a house, it is well when possible to allow the house to settle for a few weeks or months before taking up the plaster work. After plastering the house, all rooms should be well ventilated in order to allow the plaster to dry. In freezing weather it is absolutely necessary to warm the building artificially while the plaster is being applied and

while it is drying. To avoid breaking of plaster on projecting corners, it is necessary to apply to the lath before plastering, strips of wood or metal called corner beads, which are made for the purpose. In order to prevent window sash, doors and other woodwork from becoming damp on account of the wet plaster, it is advisable to have the building absolutely free from such finishing materials while the plastering is being carried on. However, the window openings should be closed temporarily by means of old sash, boards or muslin. The plastering of a building is very important and should never be neglected. (See Plate 42, Fig. V.)

Both interior and exterior plaster may be colored by using pigments. Also, the color of the sand itself determines largely the color of the finished work. White sand is desirable in case colors are to be mixed with the plaster, or in case a natural white effect is wanted. If a wall is to be painted, papered, or otherwise covered, the color of the plaster is not important.

Interior Woodwork.—When the plaster is thoroughly dry, finish wood material may be hauled and stored in the building ready for use. At this time it is important that the wood be inspected, in order that undesirable pieces as well as unspecified kinds be not set in place. Otherwise the inside material might need to be removed at a later and more inconvenient time. Interior trim, such as members which are applied directly to the grounds which have been provided in the plaster, is matched, fitted and nailed with finish nails, the heads being sunk below the

DOMESTIC ARCHITECTURE

surface of the wood and the holes thus made later filled with putty. The method of joinery of plain trim varies, depending upon the general quality of the work. In ordinary work, where common wood is employed, members of wood may be simply butted one against another; in better classes of work, wood members should be mitred, that is, the ends cut diagonally as corners of a picture frame, and fitted together; and in the best class of work, casings used as a frame should be mitred on the face and lapped on the back. This method applies principally to door and window heads where they connect with the side trim.

In cabinetwork many methods of joinery are employed by experts in securing one piece of wood to another. The common joints, besides butt and mitre joints, are tongue and groove, cupped, housed, dovetail, and others, the exact character of which it is unnecessary to investigate. It is essential, however, that all parts be so fastened together that shrinkage and warping will not damage or disfigure the woodwork. Some special precautions may be mentioned in regard to methods of making parts which are operated by the occupants of the finished house. Doors should be hung in such a manner as to allow them ample space for action. It is not well to have a doorknob in the corner of a room. Outside doors are more convenient in most cases when they open out, and are also more wind and waterproof. Usually, however, they are made to open in to allow for screen doors. Front doors should always open in, on

account of the convenience in answering the door bell. In the hingeing of casement and French windows, it is necessary to bear in mind the kind of hangings which are contemplated, since the windows swinging out must necessarily have the screen on the inside and cannot have sash curtains. Casement windows swinging in require that the screen be on the exterior, and that curtains be on the window sash itself rather than hung in the ordinary fashion.

In the actual construction of cupboards, lockers, doors, bookcases and other fixtures, according to the prepared design, it is necessary to depend to a great extent upon the carpenter or cabinetmaker for satisfactory results. Consideration should be given to the use of drawers and consequently to the weight of their contents. Large drawers to contain heavy materials should always be constructed on rollers rather than slides, so that the operation of them will be easy. One drawer pull, except for the largest drawers, is better than two.

When nailing a moulding whose function it is to cover a joint or crack, the nails employed should not bite into the trim member, that forms the joint, but into the ground member, because in case of shrinkage of the important piece of wood, splitting at the line of the nails might occur. For instance, a quarter round shoe mould employed at the angle of the floor with the wall to cover the joint between the floor and the baseboard, should be nailed to the floor rather than to the baseboard, in order to give the baseboard a chance to shrink freely.

DOMESTIC ARCHITECTURE

In case of shrinkage, this mould will continue to serve its finishing purpose of covering the joint. The same is true of flooring, which by the way is the last wood finish to be put in place. When secret nailed each board should have opportunity to shrink a fraction of an inch, which would only cause the joint between boards to be a trifle wider and not cause splitting of floor boards. (See Plate 42, Fig. V.)

All finish woodwork after it is in place should be scraped, sandpapered and rubbed to a smooth finish by the carpenter who performed the work. Floors especially should be ground down so that no edge of a board projects above the face of the floor. Since floors are the most easily damaged of all woodwork, they should not be put in place until heating, lighting and plumbing fixtures as well as finishing hardware have been installed. During other operations in the house, such as painting, varnishing, staining and more elaborate interior decoration, finished floors should be covered with paper or canvas.

Putting on of Hardware.—Finish hardware is applied to the woodwork by the carpenter, and is a part of his work. Great care must be exercised in the application in order that doors, windows and other movable parts will act without unnecessary friction. Double hung window sash should be properly balanced by the use of weights, which is sometimes a tedious operation. Casement window adjusters should be applied not only to perform properly, but to look especially well. Bolts and locks invariably require a mortise or chiseled out recess in the wood.

Unless this work is done most carefully, wood-work upon which great pains have been expended for a good appearance will be damaged. Convenient heights for window fasteners, door knobs and pulls should be taken into consideration before the hardware is put on. In many cases a compromise is necessary on account of the location of the door or window, or the distance of a part of it such as rails and panels, above the floor. Much of the finish hardware, as door knobs and escutcheons, which are usually held in place by means of bolts and screws, should not be put in place until the wood-work has received its final coat of paint, varnish or stain.

Painting, Varnishing and Staining.—The style of finish for both the exterior and interior in regard to painting, varnishing and staining should be predetermined and specified, and a reliable painter employed to furnish the materials and perform the labor. Quite often it is well for the owner to provide the materials and employ the painters, in order to assure himself that only genuine, reliable materials are used, since there is a great opportunity for unscrupulous persons to substitute imitation materials for genuine. The exact methods of application of these finish materials depend upon the effect or finish desired. Methods recommended by the manufacturers of paints are more reliable than the methods of local painters, who are accustomed to doing things in their own way. The chief precautions in painting are to allow each coat to dry thoroughly before the applica-

tion of the next, and to protect adjacent surfaces.

Perhaps the most difficult finish for wood in regard to the application is enamel. This material should be applied only to edge grain or quarter-sawed wood, unless the wood is of white pine or a similar variety, because an absolutely smooth surface is necessary to prevent waves and irregularities from showing in the finished enameled surface when subjected to high light. For a reliable finish two or three coats of enamel on top of four coats of interior paint are usually required, each coat up to the final one being rubbed smooth with mineral wool or sandpaper. On account of the tendency of enamel to flow and form beads, all liquid should be applied sparingly and evenly.

Glazing.—Glazing consists of the operation of putting in place for permanent use glass of all kinds. Originally glazing was a part of the painter's work, but of late it has been taken over by the planing mills, cabinetmakers and carpenters, who, on account of the close association between woodwork and glazing, are more capable of performing the necessary labor. Common window glass is usually held in place by means of triangular pieces of zinc, called glazier's points, and putty which covers the zinc points. In the best work back puttying is done, whereby the edge of the glass is imbedded in putty before the regular method is employed. The putty is placed on the outside of the sash. Doors, French windows and also plate glass windows should always be glazed, using wood stops to

hold the glass in place, and should have a bed of putty or other somewhat elastic material upon which the heavy glass may safely bear. Leaded glass is usually furnished by specialists and set in place by the carpenter with wood stops and sometimes with special metal contrivances.

In the inspection of the glass which is to go into a building, it is important to observe by the thickness and reflections the exact kind of glass received, and note whether or not it is the kind specified. Plate glass may quite readily be distinguished, but the quality of sheet glass is hard to determine. It is well to insist that the trade-mark of the manufacturer be left on the glass. In regard to the cleaning of glass at the completion of the building, the painter is usually required to do this, because he is practically the last man on the job, and the one who is most liable to cause the glass to be unclean. The breakage of glass in a house during construction must be paid for by the contractor who in the performance of his labor caused the glass to be broken.

The Completed House.—The house is said to be completed when all the materials and labor called for in the plans and specifications have been employed and the condition of the building is satisfactory to the owner. It should not only be finished relative to all parts of the structure itself, but should contain as well all appliances necessary for the occupation of the house by the owner. These appliances include heating, lighting, plumbing and other incidental fixtures and machines.

SKETCH PROBLEMS

(1) Show by a diagram how a beam for a ceiling is usually constructed and held in place.

(2) Show by a sketch how wood lath and plaster are applied and especially how the coats of plaster are bonded.

(3) Make a detail of a wood base showing how the shoe mould should be nailed in place. Drawing is to be at the scale of $1\frac{1}{2}$ "=1'-0."

(4) Make a scale drawing showing how common glass is held in the sash. Letter on names of all parts and materials.

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CHAPTER XI. INTERIOR DECORATION AND TREATMENT OF SURFACES

INTRODUCTION.—Interior decoration is a profession in itself and is practiced as such. It includes not only plain and elaborate treatment of surfaces, but also interior design. Interior decoration, then, may be said to embody architectural treatment, decoration of all kinds, and complete furnishings. The work of the interior decorator overlaps that of the architect, which has caused friction between the two professions. Regardless of who performs the professional duties connected with this work, the same principles are involved. Perhaps the architect is better qualified to design all built-in parts of the dwelling, and the interior decorator better qualified to treat surfaces and to design or select all furnishings including furniture, rugs and hangings.

Interior decoration and treatment of surfaces here discussed include color schemes and common treatments in general for the wood and plaster work of all parts of the house.

Color.—The general color or tone of the interior of the house is of great importance, in that color may create an atmosphere either restful or disturbing. Colors and combinations of colors used in a house should suggest tranquillity, and often create it. In other words, a home should express contentment. The greatest factor in producing tranquillity is the use of neutral tones, which, while they should not be employed in every article of the room, should form the background against which articles of utility or dec-

oration are revealed. Perhaps the best and safest colors to use are grays, gray greens, browns and buffs. Each may have a large number of variations, textures and surfaces difficult of description. It is important to consider whether or not a surface absorbs light. It is a well-known fact that a dull black absorbs practically all of the light, while a glazed white absorbs very little and consequently reflects light to a large degree. Each finish material will have its tendency one way or the other. All qualities of the materials contemplated for use must be given attention. In the color scheme of the interior of a house, it is well to carry out the same or similar schemes in all rooms, rather than to make radical contrasts, since a house in itself is better considered as a unit rather than as a group of smaller units. Doors standing open often show a number of rooms, at the same time causing a discord of color if rooms are not harmonious. However, there should be a modification of the color scheme in rooms to meet the exact requirements according to the use of each part of the house. Occasionally an isolated part of the house or the rooms on the upper floor may receive a treatment absolutely different in color from the main part.

Color has three distinct qualities, called the "constants of color." They are: purity, luminosity and hue. Purity means freedom from any other color. The standards of pure color are the colors of the spectrum. Luminosity or brightness depends upon the amount of light reflected to the eye, and varies with the degree

INTERIOR DECORATION AND TREATMENT OF SURFACES of illumination. It follows that the tone of the color is relative to its degree of luminosity. Hue depends upon the refrangibility or wave lengths of colors:—Violet has the shortest wave length and red the longest. Hue may mean color in the simple sense. In combinations of two or more colors, the hue is determined by the predominating color. A shade is produced by adding black to a color, and a tint is produced by adding white.

In decoration, harmony of color is of first importance. Means of obtaining harmonious color arrangements are: first, by neutralizing or graying the colors; second, by using analogous or like colors; third, by toning the colors with a dominant color. Pleasing effects may be obtained by a gradation of a color from dark to light values or vice versa. Solid colors used together in contrast should be separated by a narrow band of black, white, gold or gray, or of black and white. Brilliant colors are difficult to harmonize in pairs, but in case a pair of bright colors is used, one should be used in a much greater proportion either in area or intensity, than the other. No two colors should be used in similar quantities. Any two colors may be brought into closer harmony by the use of a third. No definite rules can be given for the combination of colors for decoration on account of the vast number of problems. It has been observed that the warm colors are more pleasing in color schemes than the cold ones. The warm colors are reds and yellows. Combinations of three colors may be suggested as follows: Red,

DOMESTIC ARCHITECTURE

blue and yellow; coral-red, ultramarine, and orange-amber; scarlet, olive-green and violet; orange, green and violet; purple, yellow and gray-green. These colors were the favorites of old Italian painters and show a predominance of warm colors.

Period Decoration.—By period decoration is meant the imitation of a certain historic style as used at a certain period and in a certain place. Among the common period styles are Empire, Louis XV, modern Turkish, and others. Period decoration really necessitates a special architectural, as well as decorative, treatment. Furniture, hangings, rugs and all other equipment should then conform. The essential of period decoration is absolute fidelity to the type. If imitations are not true, then the decoration is a failure. Period decoration should not be attempted except for novel or eccentric effects, and usually in isolated country houses or city apartments.

Decorative Materials.—Among the materials employed in decoration are wood, plaster, ornamental glass, metal, tile, Beaver board, oil paint, enamel, varnish, stain, wax, water color, paper, burlap, leather, tapestries, brocades, canvas, linen, silk and satin. The interior of a house ready for decoration consists almost entirely of wood and plaster surfaces left clean for the purpose.

Wood Treatments.—In anticipation of decoration of a certain character the design of the woodwork is such as to almost call for a definite treatment. A colonial house would have fireplaces, doors, windows, wainscotings and other

INTERIOR DECORATION AND TREATMENT OF SURFACES

wood details possibly of mahogany, black walnut, or other high class hard wood, but more probably of a good soft wood, in anticipation of enamel finish, with perhaps mahogany edgings. Mahogany hand rails, and tops of chair rails, edges of steps and other edgings made of mahogany, look especially well. Mouldings for all woodwork which is to be enameled should be very small and refined, because when finished smooth and white, each angle and curve and the shadows cast are presented to the eye in unfeigned sincerity, as is a marble statue. Each minute part must be true to the whole conception. Measured drawings of common colonial white enameled or painted woodwork of early days show that extraordinary care was taken in design and execution.

Hard woods of unquestioned merit should be finished naturally, or may be simply darkened. Forms and mouldings of oak, ash, walnut, mahogany and maple should also be refined, but not to the same degree as is done in enameled woodwork. The reason for this is that the texture of these woods is fine, and lines made by mouldings show remarkably well. Cheaper woods should really be stained colors to give them character, as the grain is coarse and the natural color quite often poor and inconstant. A very good treatment for common wood which does not contain pitch with a tendency to ooze, is flat paint of light color. Interior paint is not fully appreciated, but is coming into use again after a long period of unpopularity. It is far better than cheap varnish.

In general, dull finishes in paints, varnishes, stains, and in fact in all treatments of surfaces, are better than gloss finishes. Enamel looks best with a semi-dull or mixed dull and gloss finish. A possible exception to dull finish is flooring, but even a shiny floor will not stay thus for long. Wood floor treatment is a difficult problem, since rugs have happily come into use, but the floor that is most permanently satisfactory is a costly hardwood flooring left its natural color and waxed.

Plaster Treatments.—The walls and ceilings of most rooms are plastered. Ornamental plaster, which is usually a composition containing plaster of Paris, may be used in room cornices, ceiling coves, ceiling and wall panels and pattern work or staff. All plaster may be left in its natural condition, but is garish and discolored. Sand finish or rough plaster is sometimes colored before being applied, which is a very good process for rustic effects. It is more often painted with water color or calcimined to give it a tint. In the latter process, which is very cheap, the principal objection is that a nick in the finished surface shows white and must be painted over. Sand finish plaster looks well painted exactly the same color as the woodwork of the room, using a flat tone paint.

Hard finished or patent plaster, used for walls and ceilings, as well as ornamental plaster, may receive any finish that common plaster receives. Ornamental plaster is invariably decorated by the use of paints or stains applied with a brush, because it is in relief and consequently irregular.

INTERIOR DECORATION AND TREATMENT OF SURFACES

Hard finish is used with the idea of covering it with paper or other material rather than with a liquid color.

The use of wallpaper is almost universal, and rightfully so, since no other material is so economical and at the same time so artistic and serviceable. Wallpapers are of a vast number of varieties, designs and qualities, some of which may not be considered to be economical. Although papers, like other materials used to treat wall surfaces, should be essentially a background, certain pronounced designs and colors may be employed for what are really temporary effects, such as "Mother Goose" patterns for nurseries, and highly colored floral or bird designs for bedrooms and dining rooms. These papers sooner or later become tiresome, and are replaced. Cheap papers almost invariably fade, so that it is not worth while to use them.

The cheapest cloth used as a wall cover is burlap. In common work this material may be glued to the plaster, usually as a wainscoting panel, with wood on all sides, and either left in its natural state or painted, varnished or shel-laced. Burlap is serviceable, and in dull shades forms a good background for pictures. Canvas, linen, silk and satin are also glued to plaster to be used as a surface for receiving decorations in oil or water color paints. These are very expensive and used only in costly residences. Leather, tapestries and brocades are fastened to plaster walls by means of wood stops. Each piece of material is in itself supposed to be a work of art, consequently is framed by the use of mouldings.

DOMESTIC ARCHITECTURE

The walls of a room to receive this sort of decoration are divided into panels of such proportions as to produce an architectural treatment and to give each piece of decoration the proper setting. Still another means of decorating walls requiring a special permanent plaster surface is the use of frescoes and mural decorations. These are simply more or less elaborate paintings for which water color paints are generally used.

In conclusion it is well to note that walls are either used as a background for the furnishings, or as a means of displaying works of art. In dwellings the former use is far more preferable. Even though beautiful works of art do form a cover for a wall, they may still serve modestly as a background. Unpretentiousness in a house is worth far more than vulgar display.

Ornamental Glass, Tile, Metal, etc.—Some materials are used in interior decoration in a special manner.

Art glass may be employed in a feature window, but not in all windows unless a simple leaded glass sash is used throughout. The glass itself in this treatment should be clear white glass. Ornamental glass in residences should be used discreetly, and unless of good color and design should not be used at all. The question of quality, if puzzling to the owner, should be referred to an expert.

Tile, an excellent material, and substitutes, also usually reliable, produce an effect of substantiality. In floors and fireplaces, dull tiles of solid, mottled or graded colors look well. Glazed white or even dull white tile should not

INTERIOR DECORATION AND TREATMENT OF SURFACES

be used for interiors except where sanitary conditions are paramount. In order to get the best tile texture or effect, the use of tiles which differ in shade or color is advocated. A wall or floor thus made has an added interest over one made of tiles all exactly the same.

Metals in the form of ornamental finishing hardware, especially wrought strap hinges, give to a house a unique quality, but other parts, especially the design of the woodwork, must be adapted to the use of it. Board or batten doors call for strap hinges rather than for butt hinges, which are ordinarily used on panel doors. Cabinetwork may have iron, brass or bronze hardware of special design. Doors equipped with wrought strap hinges and clever latches sometimes add a charm, especially in bungalow work. The lighting fixtures should harmonize with the hardware and conform to the character of the room, or be in keeping if an historic period style is followed. The same is true of radiators and all other architectural appliances.

There are in the market a number of cheap materials for covering interior walls, of which Beaver board is one. This is a strong, thin material made of fibre, and is nailed directly to the wood studding of the partition walls. It is necessary to cover the joints where pieces of beaver board meet, with wood strips, thereby forming panels about thirty inches wide. Beaver board may be painted or tinted any color. A cheap method of finishing interior walls and ceilings is by boarding them over, stretching cheesecloth or muslin and applying the wallpaper to the

cloth. The paper usually sags or tears and is thoroughly unsatisfactory after a very short period of use.

The Living Rooms of a House.—Rooms occupied a great deal should be above all restful. Materials used for treatment are usually determined by cost, but a very humble room may have the quality of restfulness, which an elaborate room may not. In fact, when cost is not an important consideration, the tendency is to overdo, and thereby destroy effects which might have been pleasing.

To secure restfulness other considerations than decoration are involved, chief of which are the design of the room itself, relative to doors, windows and architectural features, and style and arrangement of furnishings. Colors used on surfaces should not be vivid, or even bright, but dull and neutral. Old ivory or cream white enamel of semi-dull finish used on the woodwork, oatmeal paper of light brown on the walls, light buff paper on the ceiling, and any good flooring with, perhaps, Oriental rugs, should, with proper furnishings carrying out the color scheme, produce a harmonious and restful interior. Harmony of color as a study develops good taste in house decoration.

In following out color schemes, for decorating and furnishing living rooms, it is not well to slavishly hold to the color and tones of the scheme. If this is done, the effect will be monotonous, which is not restful. There should be judicious departures in color, chiefly in the furnishings, and especially in certain architectural

INTERIOR DECORATION AND TREATMENT OF SURFACES
features such as fireplaces, floors, and ornamental glass windows. As a rule the gradation of color should be such that the ceiling is light, the frieze less light, the wall and wainscoting darker, and the floor darkest. This principle is worthy of careful notice, but exceptions are possible. A floor may be of very light wood, while the gradation of color starts dark at the base of the wall.

In any composition or decorative scheme, a dash of color is a welcome relief in holding the attention for a moment.

Bedrooms.—Treatments for bedrooms should have the quality of freshness regardless of the color scheme employed. While women usually prefer white, pink, blue or yellow rooms, men generally prefer brown, gray or green. Any color scheme that is not disturbing and that does not take on a dingy air may be satisfactorily developed. Wallpaper as a cover for plaster surfaces is used almost to the exclusion of other materials in bedrooms. Paper is readily removed and replaced when no longer bright and clean. In repapering it is always advisable to take the old paper off, not only because the new fits better, but because it is a more sanitary method. On sanitary grounds the painting of bedroom walls is preferable to papering.

Woodwork of bedrooms may well be white or cream in color, firstly because it is neat, fresh and easily washed, and secondly because any bedroom set of furniture will conform to it. A very handsome treatment for a bedroom is to make the woodwork exactly like the bedroom

DOMESTIC ARCHITECTURE

set, of maple, walnut, mahogany, or any hard wood. Maple flooring is very satisfactory for bedrooms.

For inexpensive treatments, white paint may be used on the wood trim, and gray paint on the floor. Sometimes matting over a common floor proves very satisfactory. In any treatment, the quality of freshness is the essential.

Kitchen Treatments.—Since in a kitchen cleanliness is of first importance, the treatment of materials should suggest it, and decoration need not be neglected. Rather than to use materials and colors that do not show dirt, it is far better to have all surfaces so treated that dust and dirt will show, but will be easy to remove. Here glazed or glossy finishes, or semi-glazed, which is the same as semi-dull, are desirable. Plaster may be given a slick, steam-proof varnish or paint, and the wood given an enamel finish. Wallpapers having a glazed surface are in common use, and if of good quality are satisfactory. In regard to the woodwork in kitchens, the details should be such as to be most sanitary. There should be no crevices or angles not easily reached with ordinary cleaning apparatus. Severity of design is becoming to the nature of the kitchen. Simple wainscotings are very serviceable and attractive, and may be counter height, thereby forming a continuous line around the room. Incidentally, counters and other surfaces in actual use should not be treated with paint, varnish or any other material except oil. However, such working sur-

INTERIOR DECORATION AND TREATMENT OF SURFACES
faces may be covered with a matting of rubber or oilcloth.

Tile work in kitchens is highly serviceable, wainscotings, counters, facings for built-in ranges and floors being the chief parts constructed of this material. The main objection to tile floors is their coldness, and the discomfort experienced by some who use them many hours a day. No wood floor or finish for wood floor in the kitchen may be relied upon to give permanent satisfaction, on account of the abuse that the floor is subjected to. Some varnishes will last a while, but will be scraped and scrubbed away, and a new coat be made necessary. Eventually the floor will be streaked and spotted, and also worn and uneven where footsteps continually mar it. Perhaps a floor left in its natural condition and oiled is better than a varnished or painted surface. Constant scouring is then necessary to keep it in good condition. A hardwood floor of oak or maple is best, if tile cannot be afforded. A cheap wood floor may be made very serviceable by laying upon it oilcloth or linoleum. Linoleum is especially good, but will not wear well unless the wood floor below is made perfectly smooth, either by dressing down or covering over with paper, cloth or other material. A very good material for kitchen floors is a patent substance similar to asphalt, which has the appearance of tile, but is not so hard.

Color in a kitchen should be such as to suggest perfect sanitation. The best colors are white and blue, but with white or cream may be used green, brown, gray or other color. Colors may

appear in tile borders, linoleum, wallpaper, painted surfaces and in simple hangings. The room should be bright and pleasant, but not cluttered. Extra large kitchens in farmhouses and elsewhere should have more color than small ones.

Bathroom Treatments.—Surface treatments for bathrooms may be much the same as those for kitchens. Waterproof materials are practically essential, where water and steam are so prevalent.

Porch Treatments.—Porches are really exterior features, and should be treated much the same as other parts of the exterior. These decorative treatments depend chiefly upon the materials used. Light-colored paints and stains generally look better than dark. Masonry should not be painted under any circumstances, unless as a preservative measure. Porch floors of wood should receive several coats of exterior floor paint of neutral color, while the ceilings should be painted white or buff. It may be here stated that more than two colors of paint on a frame house should not be used, except perhaps in very limited quantities. The main color should cover the body of the house, while the other should serve only as a trim color. Alternate color effects should never be used.

SKETCH PROBLEMS

(1) Draw the main wall of a familiar living room and show a scheme of architectural treatment and decoration and arrangement of pictures. Describe each material and article used.

(2) Make a design or scheme of treatment for a nursery wall, assuming doors and windows where desired.

(3) Design a pair of unlike strap hinges to be used on the main entrance door of an English cottage. The metal contemplated for use is wrought iron.

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DeWolfe.—The House in Good Taste.

CHAPTER XII. HOUSE FURNISHING

ARRANGEMENT of Furniture.—Closely related to design of rooms and spacing of openings and fixtures is arrangement of household articles. The principles of composition in general may be applied to these. In all arrangements it is essential to obtain balance, unity and simplicity. It is good practice to study an arrangement of a room by means of a sketch or drawing made to a certain scale. In this way it will readily be seen that only important units or articles employed in furnishing have a place, and that ruffraff is not only unnecessary but altogether undesirable. Before buying new household equipment, a drawing is almost essential, in that it plainly shows the number and size of necessary articles.

In the arrangement of furniture in a room it often happens that most of the pieces are already on hand, and must be adapted for use. Rooms that are symmetrical in plan, that is, rooms which have the main features in the centre of the various sides, are far more easily arranged than rooms of unsymmetrical design. This accounts for the difficulty in placing furniture in the rooms of a great many houses, it being difficult to obtain balance on account of the lack of that element in the room itself. If built-in parts of the room are not symmetrically placed, then it is of course difficult to locate furniture relative to those room features. Space should be utilized to the fullest extent. As much space as possible should be left "in the

clear," that is, as much floor space as possible should be left unoccupied. It is very important that circulation or means of traversing the room be provided by allowing free passage from door to door. Chairs, tables and other pieces of furniture should be set where most used, so as to be in a state of readiness, without more shifting than absolutely necessary. Reading table, lamp, magazines, and easy chairs should be placed in the proper relation one with another for instant use rather than distributed here and there to form a pleasing arrangement regardless of actual use. By placing the large pieces of furniture on the main axes of the room, the element of balance is obtained. For instance, in a symmetrical living room a large table may be set in the centre, midway between a fireplace and a large window, thereby being on an axis. Furniture should not be set diagonally, as a rule, but in straight lines with the walls. The same is true of rugs. Pictures on a wall should be hung in straight lines practically level with the eye, rather than staggered up and down or hung in a diagonal row. Furniture itself having straight lines rather than diagonal lines is better. In the arrangement of a room the design, the size and the color of the various articles should be considered and consequently placed so that adjacent articles are in harmony. It is well to cluster or group like pieces of furniture in a certain part of the room.

There are two distinct methods of arrangement which may be employed in a living room. One may be called a winter arrangement, and

the other a summer arrangement. In the former, large pieces of furniture may be grouped in the centre of the room, on a large rug, perhaps in front of the fireplace. Here a davenport may face the hearth with a table immediately behind it, while three upholstered chairs may be set immediately adjacent to it, forming a group of five large pieces of furniture. The outside edge of the room is then left practically clear, except for the smaller articles. In the summer arrangement the centre part of the room is left clear, giving the impression of roominess, and consequently coolness. Articles of furniture may be grouped around the walls, the large pieces occupying positions where space seems correspondingly large. The davenport may be set under a group of windows or even in front of the fireplace, while the reading table may be removed to a rather inconspicuous position. The winter arrangement has the appearance of being snug, while the summer arrangement has the appearance of being roomy. (See Plate 44.)

Pictures.—The use of pictures is twofold, one being for the purpose of display, and the other for the covering of wall surface. Assuming that only good pictures, and not enlarged photographic portraits and cheap prints are to be hung on a wall, the arrangement should be such that the spacing, regardless of the subject of the picture, is pleasing, and that the pictures themselves be harmonious one with another and pleasing in general. As stated before, the proper height of pictures above the floor is the height of the eye, or a little more. In this last con-

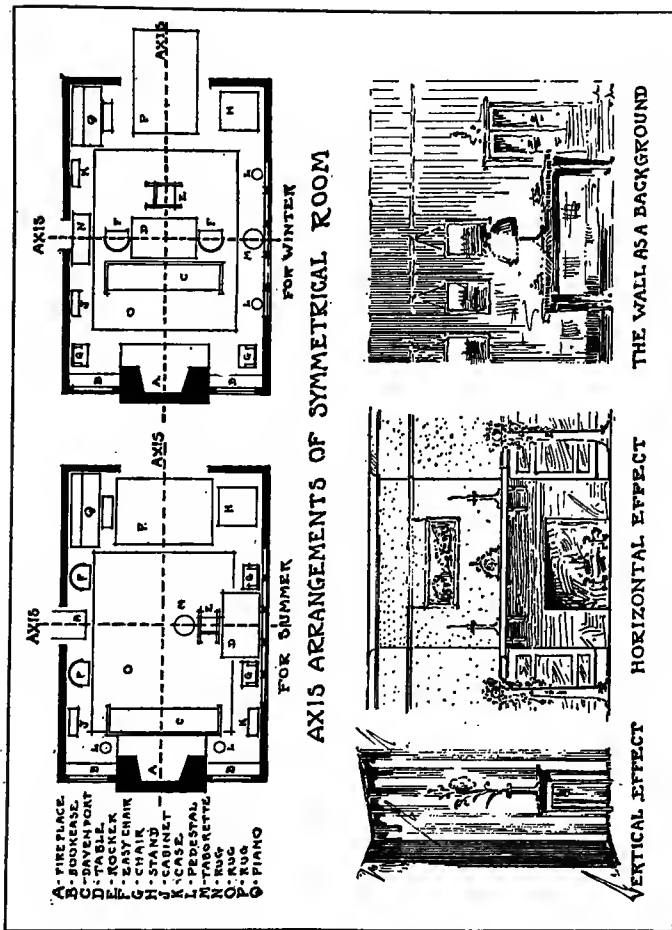


Plate 44
 DIAGRAMS SHOWING ARRANGEMENTS

sideration there may be exceptions, but not for the picture of ordinary size. Very large or very small pictures may be arranged especially. To keep a room from having a stiff appearance, it is necessary to make a departure from the symmetrical and formal. This is accomplished by the use of little things which may be on hand and which are probably of peculiar personal interest. There should not be an abundance of such small pictures and knickknacks, no matter how valuable they are from any standpoint.

Miscellaneous Articles.—The arrangement of articles on the table is important in the matter of the general effect of the room. It may be said that as few articles as possible on any table should be employed, and these should preferably be placed with the lines of the table rather than diagonally or irregularly. The articles employed for table use are so varied that no definite suggestions for table arrangements may be given, except for the dining room table. Here a linen centrepiece having the same general form as the table itself may be employed, with a single article such as a candelabrum, lamp or vase of flowers upon it. In the arrangement of other cloths upon the dining table, it is well to keep them as simple as possible, and have them conform to the lines of the table itself. The entire equipment of the dining room should be simple and the arrangement formal and positive.

Mantelpieces, shelves and pedestals should never be cluttered with small articles of decoration. It is far better to place perhaps only one large ornament in the centre, with a minor orna-

ment on each side, and consider the arrangement complete. For pedestals, of course, only one article is possible. Shelves which are to contain books, or kitchen shelves which are to contain jars, cans and other kitchen articles, should be arranged systematically according to use. It is interesting to note that harmony of line is so agreeable with utility that the two go hand in hand, and may be called system. For instance, a pantry shelf which is to accommodate a number of jars will look best and be most convenient when the large jars are placed in a row behind, and the small jars in a row in front. This principle may be applied throughout shelf arrangements of the house. Books should not be arranged according to size and color, but according to subject-matter. However, when possible and compatible with subject-matter, the size and color may be considered.

Flowers.—Flowers may be so arranged as to accent their own beauty, and form an agreeable spot in an otherwise dull room. A single rose on a long stem set in a tall glass vase, perhaps on a pedestal, gives an unquestionable vertical effect which while not remarked by all would be felt by all. This effect would be further emphasized by giving the whole a background of vertical lines, such as upright wood paneling or striped wallpaper. Not only will an American Beauty rose, but also long-stemmed lilies or irises produce a pleasing vertical effect, if properly arranged. Short-stemmed flowers like nasturtiums, growing in a low mass, suggest a like arrangement in vases, consequently a

bowl should be employed for them, set where the mass is most effective. Vines that grow downward should always be set in such a manner that there is full opportunity for them to hang, while vines that grow upward should be provided with a little trellis or small pole. Some flowers look best when forming a horizontal effect or a series, perhaps high in the centre or high at the ends. Potted geraniums are a sample of this type of flower. The study of the arrangement of flowers is very interesting, and would be of permanent and practical use to all. Perhaps in most people the æsthetic sense really guides in the matter of arrangements of any kind, but the application of known principles is always helpful. (See Plate 44.)

Furniture.—In the selection of furniture for a house, appropriateness is the chief governing factor. Appropriateness means not only the use to which the article is to be put, but the appearance of it in the place for which it is intended. It is well to avoid pretentious furniture and curios, and to get real rather than imitation things. Imitation furniture will eventually reveal itself, so that a pine table is better a pine table in the beginning than an imitation mahogany. Practically every material has a worth or a use of some kind, and it is best to have it stand on its own merits from the beginning.

Since furniture is used by all, the general characteristics of it are known. Willow, reed, upholstered and other kinds of furniture each have a place. Certain types of furniture which

may be called period are in vogue in the United States, being originals or copies of models made by English chairmakers. The three best known English chairmakers of the eighteenth century were Chippendale, Hepplewhite and Sheraton, practicing in the order named. Chippendale followed the French method of making furniture, using a French scroll for the foot, a bow at the top of the back, and elaborate carvings throughout. The proportion of his chairs was very good. Hepplewhite made chairs much lighter in weight than did Chippendale. He used both carvings and inlaying, and finished the chair backs with paint or Japanned work. Next came Sheraton, who strengthened the light chairs of Hepplewhite and made the back rectangular in shape. Models of these and many other types of furniture may be seen in numerous places, and by the use of texts the subject given thorough study. Another type of chair that appeared in this country about 1730 is the Windsor chair, which is far more simple than the previous types. The Windsor chairs are made using round turned legs and spindles in the back. Originally Windsor chairs were painted green. The models vary to quite an extent.

New types of chairs are being invented and manufactured continually. Quite recently the type of furniture called "Mission" appeared. It is very heavy and square in construction,—perhaps too much so for ordinary house use. Any piece of furniture that is of good design and honest construction may be employed where there is a place for it. It is not necessary that a

certain kind of furniture be used in a certain place.

Hangings.—Hangings or draperies as a part of the furnishings are more important in decoration than is generally conceded. In most cases the hangings should follow the general color scheme, but to avoid monotony floral designs, stripes, and geometrical patterns may be employed. Sometimes sharp contrasts between light curtains and overhangs give good results, especially when the light curtain is similar in color to the wall surface. The function of curtains is to soften the architectural lines of the room, and thereby remove the severity of the aspect. Curtains should not cut off light and air to an appreciable extent, and should not be of such material as to catch dust and retain odors. Practically any material that does not fade may be employed in one way or another for curtains of various rooms. However, certain well known kinds of goods are generally employed to meet the requirements. Texture and quality of draperies is important in the selection of them.

Floor Coverings.—For floor coverings, matings, carpets, rugs and linoleum are employed. Each has its place, but the selection of patterns and colors is important. Bold designs such as large floral patterns in high colors should be avoided. Mellow tones of rather solid color are best. Oriental rugs especially have these characteristics, and have also the quality of wear. Other rugs, manufactured in this country, have been found to be very desirable in every respect.

Throughout the decoration and furnishing of the interior of a house, the great thing to be attained is harmony in the broad sense of the term. Laying aside all rules and conventions we must depend upon the cultivation of the taste and inherent culture for producing an effect pleasing to ourselves and to others. All parts must be reduced to the absolutely simple in the process of home furnishing.

SKETCH PROBLEMS

(1) Draw a plan of a familiar living room showing architectural features and indicate an arrangement for a new and complete set of furniture for that particular room. Scale $\frac{1}{4}" = 1' 0."$

(2) Draw a plan of a dining room, show an arrangement of equipment and describe each article or set of articles.

(3) Make a sketch of a simple mantelpiece showing an arrangement of articles for decorative and useful purposes.

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CHAPTER XIII. APPLIANCES

POWER.—Houses, especially isolated establishments, may well be provided with power for operating house and farm machinery. The energy for this purpose may be provided by engines, water wheels, or windmills. The common method of obtaining power is by the use of a gasoline engine, which may be either air or water-cooled, and is an economical machine. Kerosene and hot air engines are also in use. On estates where a good flow of water is available, water wheels may be constructed, forming a very cheap and permanent source of energy. In the past, windmills have been very serviceable and of low cost, and may still be used.

Dynamo electric machines for supplying electrical power require one of the previously named types of power to operate them. These machines are of two general types; one for generating an electrical current, called a generator, and the other for converting electrical energy into mechanical energy and thereby operating machinery, called a motor. Dynamo electric machines are used also for changing the voltage of currents of electricity, converting one voltage into a higher or lower voltage. These are called converters and transformers. Still another power, especially for electric current, is obtained by the use of storage batteries, but these are economical only for small consumptions of electric energy.

House Electric Plants.—For operating house machines, and for illumination, the house electric plant is the most convenient, and although

the first cost may be considerable, the expense of operating is slight, especially if the source of power is not too costly. House electric plants may be used for operating kitchen ranges, laundry machines, churns, separators, and other machines, and if used for one or two devices may be used for practically every device without much additional cost. The economic value of such plants lies in the general utility of them, and unless applied to practically all machines of the establishment, both indoor and out, much of their advantage may be lost. Besides the original power plant, a generator and motor are necessary for performing all of the functions of the electric plant. Small electric light plants will furnish current for perhaps a hundred lights at a low voltage, and in general use need be operated for only a short time each day, because a storage battery is used to collect energy which is given out as required. Both light and power may be supplied from the storage battery or direct from the dynamo at the same time. The entire operation of a house electric plant is automatic, except for the operation of the engine itself.

Acetylene Gas Plant.—Acetylene gas has been found to be very efficient for lighting isolated dwellings, and can also be made very safe. The installation is placed in the basement of the building, and runs automatically. The machine consists of a gas generator and a gas tank to hold the gas supply. The generator is a steel tank holding water, into which crystals of carbide are slowly dropped, which when coming

into contact with the water, form the gas. The feed of carbide is regulated by a mechanism independent of the pressure of the gas generator. In order that a machine may not generate gas so excessively that an explosion would occur, a safety valve allows the surplus gas to escape outside of the building through a blow-off pipe. The regulation is provided by an apparatus which starts the generating of gas so soon as a jet is lighted. The whole machine is so regulated as to produce the amount of gas consumed by burning. The cost of lighting an average house for an entire year is not more than twenty dollars. The original cost of an acetylene gas plant is also reasonable.

Water Supply.—The supply of water for a country place is often a serious problem. If a natural supply of water at a considerable elevation above the house is available, it is well to provide a reservoir from which water may be piped to a pressure tank in the attic of the dwelling. This condition, however, is not common, so that it is necessary, if a convenient supply of water is desired, to install a special apparatus. Again it is necessary to depend upon an engine water wheel or windmill, to fill the pressure tank with a constant water supply. Sometimes this is done by means of pumping directly into the attic tank. A better method is to install a compression tank or air compressor in the basement of the dwelling, or below the grade outside of the building, which forces water throughout the pipes without the use of other pressure.

A compression tank is a cylindrical steel tank

with a hand or power pump attached, drawing water from the source into the air-tight enclosure. By continuous pumping of water, the air at one end of the tank is compressed, which produces a constant pressure throughout the system of piping to the fixtures. By opening a faucet the compressed air is relieved, producing a strong current or flow of water. When the tank is at high pressure the current is of course much stronger than when it is at low. It is necessary occasionally, perhaps daily, to pump the compression tank full of water. When water is not drawn from the faucet, the air pressure inside of the compression tank is reduced by reason of the water taking up some of the air. To obviate this difficulty, an air valve is used in connection with the system.

Still another method of supplying water to an establishment is by the use of an air compressor. By this machine, air is highly compressed and thereby forced through a pipe to an apparatus in the well, which as long as the air pressure is sufficient injects a supply of water into a large pipe from which all fixtures on the premises may be supplied with a constant flow.

Hot Water Supply.—The most common device, besides the regular hot water tank and coils, for supplying hot water to a residence, is the gas heater. Gas heaters are of the ordinary type, instantaneous or automatic and constant. For providing hot water periodically a gas flame may be applied to a small tank of water which is outside of the large supply tank, and by a proper system of piping a ready supply

of hot water may be provided. In instantaneous gas heaters the cold water flows through a coil of pipe of conductive quality against which a blue gas flame is applied. The water passing through this coil becomes hot by the time it reaches the far end, where it may be drawn off through a faucet. For a gas heater it is necessary to provide a pipe for carrying off gases of combustion, which may be poisonous. These heaters are supposed to be used for a few minutes at a time only, and not for providing a constant supply of hot water.

Automatic gas heaters have been invented which require a small constant flame of gas. They are usually so arranged that the opening of a faucet starts the gas burner and consequently keeps up the supply. The apparatus consists of a coil of pipe for the heating of water under which the gas burners are placed. A hot water faucet being turned on draws water from this coil which when drawn also becomes heated by the automatic turning on of the gas burner. No supply tank is required. To ignite the gas at the heating coil, a pilot light is left constantly burning. The cost of operation is rather high when a large amount of hot water is used, or when the gas rate itself is high.

Vacuum Cleaners.—Vacuum cleaners are of several types. The common ones are the installed machine, consisting of a vacuum pump in the basement with a set of pipes leading to it and a sweeper to be operated in the rooms of the dwelling; and a small portable machine consisting of a suction pump and sweeper, all

DOMESTIC ARCHITECTURE

operated within the room, being connected to an electric outlet. In any vacuum cleaner the mechanism involved is a vacuum tank which by suction extracts small particles of dust from the articles cleaned. The portable type of machine is perhaps the most practical, and not expensive. Only large houses really need an installed pipe system of vacuum cleaning.

Incinerators.—An incinerator is a device for burning rubbish of all kinds. They are especially desirable for consuming the dust collected in the tank of a vacuum cleaner, since other disposal of it is difficult. A rubbish crematory or incinerator is highly efficient for burning garbage, and is perhaps the most sanitary and convenient method of disposal of all such refuse. These machines may be set up on the floor of the basement, or may be set into the wall of the kitchen or other room. It is, of course, necessary to provide for them a draft and a smoke flue. The necessary heat may be provided by the use of gas or electricity.

Refrigerator Plants.—For large houses in the country, and also for other dwellings, a house refrigerating system has come to be an economical and most convenient asset. It is especially desirable for houses where ice is not available. A plant of this kind includes a refrigerating machine and a cold storage chamber. The best machines produce cold by the condensation of ammonia forced through coils of pipe, but some machines use brine or ammonia brine for refrigeration. It is of course necessary in all these machines to provide power from an outer source.

House refrigerators may be so placed in the dwelling as to be highly convenient by setting the compressor and electric motor in the basement, and the refrigerator in the pantry above. There may be a number of refrigerating chambers, and an ice making compartment in connection with the entire apparatus. A refrigerator may be so small as to be placed under a pantry counter. In all refrigerators it is advisable to have several distinct compartments in order that various kinds of foods may each have a compartment of its own.

House Telephones.—House telephones may be arranged in a number of systems, including from four to a dozen instruments. The ordinary system provides at each instrument a set of buttons which when one is pressed gives a call to any desired room. All that is required for an installation of this kind are the instruments, wire and batteries. They are usually intercommunicating, with an instrument in practically every room, and perhaps in the garage.

Dumb Elevators or Lifts.—A large number of architectural appliances, such as the wood lift, dumb waiter, and other lifts, are simply hand operated elevators. They consist of a shaft from the basement to a room above, equipped with slides or runners, ropes and pulleys, and a conveyance of some sort. They have been found especially convenient as dumb waiters for carrying dishes from a basement kitchen to a dining room above, or to some other part of the house. A dumb elevator for general purposes, such as carrying furniture, linen and

packages, may well be installed in any two-story house for general utilitarian purposes.

Laundry Machines.—A large number of electrical machines for the home laundry are in the market. They include washing machines, driers, and ironing machines of various sorts, modelled after the highly efficient machines of laundry establishments, but made in small size. Perhaps the best type of washing machine is one in which a wringer is attached, and which washes the clothes by a violent rocking back and forth. Some machines are not economical on account of the severity of the process on the clothes being washed. Laundry clothes driers may be set up in the basement or in the attic and used the year round. The drier consists of a number of iron compartments containing rods for hanging clothes. The compartments may be removed separately for convenience in handling clothes. Heat for drying may be furnished by a stove or other heat placed beside the drier. A constant current of heated air is made to pass through the machine, carrying off the vapor from the clothes through pipes.

Miscellaneous Devices.—There are many small devices for household use which require only hand power for operation. One of the most convenient is a small crane which may be hung on a removable bracket outside of a door on a stair landing, probably next to the driveway. Here trunks and furniture may readily be hoisted from a dray onto the stair landing and taken to any part of the house without undue labor and destruction of finish materials

in the house. Cranes are desirable on the back porch or over a cellarway for lifting heavy boxes and barrels. The crane may consist of only ropes and pulleys suspended from a substantial bracket or beam overhead.

For the kitchen a number of devices have been found convenient. A small ventilated cupboard may be set on brackets in the open kitchen window occupying the place of the screen, and when not in use may be stored in a closet. The cupboard should have doors on the inside, through which the contents of the cupboard may be reached, and a dust-proof screen on the outside. A box set in the wall between the back porch and the kitchen for holding milk bottles is handy. Such a box should be self-locking; that is, milk, when placed in it from the outside should be secure except from the door on the inside. The device is called a self-locking box for milk bottles. Clothes driers built from the kitchen window with a rotary top are convenient. They should in all cases be removable. Garbage cans with lids raised by a lever operated by the foot have been found satisfactory.

A very useful appliance and one that should be incorporated in every house is the fuel window to take the place of the ordinary window in the fuel room of the basement. On account of the tendency of the ordinary window frame to become battered and the glass of the sash broken, the fuel window is desirable. It consists of a metal frame and a metal hopper which tilts outward, forming a pocket or a slide through which wood or coal may be passed. The slide

from the window may be continued by the use of a long metal contrivance which carries the fuel well inside of the basement wall.

Strong boxes for the storage of silver and jewelry and even valuable papers may be incorporated in the masonry walls of a dwelling. The best location for such a secret box or chamber is in the wall of the chimney, inside of the main walls of the building. Here an iron receptacle may be built in with the bricks of the wall, made heat-proof and even fire-proof and supplied with a lock and key or a combination lock. In case of the destruction of a building by fire, the base of the chimney usually remains standing, and the strong box within the masonry should be intact. All iron safes, whether small or large, should be supported by and enclosed within walls of brick, stone or concrete and be insulated by means of an air space and also by the use of insulating materials.

SKETCH PROBLEMS

(1) Draw a sketch of a convenient device to be used in the house outside of the kitchen.

(2) Sketch a device to be used in the kitchen.

(3) Show by a drawing an appliance for lifting heavy articles from a truck to a stair landing within the house. This appliance is to be convenient and not unsightly and may be removable in part or in whole.

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CHAPTER XIV. HEATING AND VENTILATION

INTRODUCTION.—The original form of heating was the camp-fire, laid in the open. For many hundreds of years the open fire continued to be used as a means of heating but was laid inside of the walls of the building, the smoke escaping through the roof. In medieval castles this form of heating was in vogue, up to perhaps the sixteenth century when the open fire was moved to a niche in the wall which eventually developed into the modern fireplace with a chimney. For several hundred years more the open fireplace remained the sole contrivance for heating, but eventually the stove was invented which was not a great departure from the original method. The fire was simply enclosed within a metal box which tended to conserve the heat and distribute it more evenly. Since the origin of the stove, great developments have been made in the way of heating and ventilation but always the fireplace remains in great favor.

The best systems of heating are those in which ventilation is a part of the system, that is to say, the actual heating requires a constant supply of fresh air to pass into the room and out again. Of the systems which have this characteristic the first is the fireplace and the last is an elaborate indirect method of steam heating, employed especially in schoolhouses, churches and theatres. Of the other kinds of heating which, by the way, are commonly used in dwellings, the most important are hot air,

direct steam and hot water. Each has a place in which it may be used economically. The principles of each kind of heating will be discussed separately.

Fireplaces.—On account of the cheerful comfort of fireplaces as well as their ventilating qualities, they not only have always held a high place in the opinion of home builders but will probably continue to do so at all times. The main objections to them are the amount of labor required to operate them and their inadequacy in heating large rooms during cold weather. In combination with other heating apparatus they are invaluable as a means of warming the room in moderately cold weather and in keeping the room constantly in a state of ventilation.

Furnace Heating.—For the small residence of perhaps six or eight rooms, heating by means of hot air is probably the most economical and best. Here if the furnace and pipes are properly constructed a constant supply of fresh warm air is entering each room and the outgoing air is constantly escaping either through prepared ventilating ducts or by leakage. The first cost of installation is very small, repairs are seldom necessary and operation is most simple. Wood, coal, gas or oil may be used as fuel. Among the common faults of hot air furnaces are overheating, imperfect distribution of heat and vitiation of the fresh air by gas. These faults may be eliminated by skillful installation of the apparatus.

A hot air furnace consists of a stove or heater

in a brick or iron case, allowing a chamber of air between the two. The supply of fresh air enters the lower part of the chamber and after passing over the heated surface is conducted by means of metal ducts to the various rooms of the building. The mechanism is quite simple. In order to gain the greatest efficiency from any furnace it is necessary that it be properly designed. Most of the heaters which have been in the market for a number of years are reliable. Perhaps the heater which has the greatest radiating surface on the stove or firebox relative to the size of the air chamber will give off the most heat for the amount of fuel used. Also the draft of air passing through the firebox to the chimney should have a devious route in order that all the heat possible, carried by the fumes of combustion, may be utilized for heating. As a means of conserving heat the furnace and the hot air ducts should be insulated by the use of asbestos or other material. The supply of fresh air should be taken from the outside of the building and should be screened at the intake in order that dust may not circulate through the air chamber of the furnace and into the rooms of the dwelling. There should be two fresh air intakes from the outside each with a regulator so that either the one or the other or both may be used according to the direction of the wind, otherwise a large amount of cold air may circulate so rapidly that it cannot be heated before escaping from the hot air chamber to the registers. Hot air registers unlike radiators should be on the inside walls of

rooms either in the floor or in the base of the wall. Probably the base of the wall is the better position. No hot air duct should extend a great horizontal distance from the furnace lest hot air (carried only by gravity, or its natural tendency to rise) should not be properly conducted to the outlet. This indicates that the furnaces should be in the centre of the basement of the dwelling or toward the side of the building against which the cold winds of winter blow.

A very satisfactory scheme of heating is the combination of hot air and hot water. This is accomplished by the use of a hot water tank in the upper part of the furnace that supplies radiators in the building with heat and is therefore an auxiliary to the hot air. Ordinarily these hot water radiators are placed in isolated parts of the building because hot water will more readily reach radiators than will hot air reach registers when the rooms are far removed from the source of heat.

Steam Heating.—There are two distinct kinds of steam heating. In the one the radiators are placed in the room which is to be warmed. This is called direct radiation. In the other the radiators are placed outside of the room, usually in the basement and are enclosed within a fresh air chamber or plenum, where air from the outside may pass over them and on through the registers into the room. This is called indirect radiation. The latter, as stated before, is a ventilating as well as a heating system, while the former is simply a means of heating the air

already in the room. In some respects indirect radiation is like furnace heating, since in both fresh air passes over a heated surface, thereby becoming warm, and enters the room through a register. There is still a third kind of steam heat called the direct-indirect. By this method each room is supplied with one or more radiators but instead of being placed directly in the room are placed just below the floor and the cold or fresh air caused to pass over the radiating surface into the room thereby heating it. The common method is the first or direct radiation and is also the most economical but the least healthful, since no ventilation is provided. It follows, then, that rooms heated with radiators in them should be provided with special means of ventilation either in the form of ducts or fireplaces. In the case of indirect radiation an outlet as well as an intake is provided for the circulation of air.

Relative to the systems of steam heating, there are two. One is called the gravity or low pressure system and the other is called the non-gravity or high pressure system. In the former the steam is under only a few pounds pressure and the water of condensation from the various radiators returns to the boiler by its own weight. In the latter the steam is under a high pressure at the boiler but is reduced in pressure before entering the radiators. The water is made to return to the boiler by the use of pumps or other special machinery. The boiler and the kind of radiation has nothing to do with the system employed since either system may be

used for the same kind of radiation. However, high pressure systems are commonly used only for large plants while low pressure systems are used in general.

The apparatus used in steam heating is quite elaborate and requires for its installation an experienced heating engineer. The efficiency of a steam heating plant can be determined only by test so that a specification usually calls for results rather than for particular mechanism. In all installations a guarantee as to efficiency and fuel consumption should be required. The boilers in themselves are of three kinds, called horizontal tubular boilers, firebox boilers and sectional boilers, the latter being made with either vertical sections or horizontal sections. Systems of heating for gravity systems are three in number: complete circuit system in which the main steam pipe leads to the highest part of the building first and then to the various rooms; the ordinary one-pipe system in which the main pipe runs around the basement and the risers are taken from it; and the two-pipe system in which all pipes to radiators lead back to the boiler necessitating two connections in the radiator itself. Perhaps the ordinary one-pipe system is the most economical for residences.

Radiators are made in a great many shapes and with any capacity or amount of radiating surface. The principle of radiators is to expose to the air as much heating surface as possible in order that the heat conveyed to them by steam may be utilized in heating the room. The style and shape of a radiator is determined

by the position which it must occupy. This position should be under or near an outside window since that is the coldest part of the room and usually the source of fresh air. A window with a low sill, to have a radiator immediately beneath it, requires that the radiator, be, perhaps, no more than thirteen inches high in which case, however, it may be quite thick. A narrow wall between outside windows to accommodate a radiator requires a tall thin form in order that it may not be an obstruction. Curved window-bays may have curved radiators, and window seats may have specially designed radiators to fit underneath them. In regard to the size of radiators, a two-column radiator is about eight inches deep and may be any height. A three-column radiator is about nine inches deep and may be any height and a four-column radiator is about ten or eleven inches deep. All radiators are composed of a number of sections each about two and one-half inches wide, therefore a radiator is given a certain capacity or a certain number of square feet of radiating surface by selecting a form of radiator of a certain height and combining as many sections as is necessary. Ordinary patterns may be selected from the stock of several radiator companies. The main factors that determine the amount of radiation required in a room are the cubic contents of the room, the outside wall areas and the outside glass surface. By certain formulæ which take into consideration these factors the size of the radiator may be determined. Windows of course involve a much greater

heat loss than does the same area of wall space.

Hot Water Heating.—Hot water heating is accomplished by the use of exactly the same paraphernalia as is used in steam heating with the exception of the size of the radiators or rather their radiating surface. For hot water heating, radiators must be about one-half as large again because the average temperature of hot water in radiators is 170° Fahr., while the average temperature of steam for heating is 220° Fahr. Therefore hot water will not raise the metal to as high a temperature as steam and consequently the metal will not radiate the same amount of heat. This system of heating consists of circulating hot water throughout the pipes and radiators, the flow pipes being attached to the top of the boiler and the return pipes to the bottom. The water in the boiler when heated rises and when cooled in the radiators descends where it again is heated, thus there is a continual flow. There are two systems of hot water heating. One is called the open tank system in which an open expansion tank is connected to the system to receive the increase in the volume of the heated water and having in it a vent pipe to the outside air. The other system is called the closed tank or pressure system in which a similar tank is used and the vent pipe is closed and a safety valve attached. The first or open system is the more safe. The advantage of hot water heating over steam heating is in the rapidity with which a house may be warmed after the fire is started in the

boiler, and in the great length of time that radiators remain warm after the fire is out. In a hot water system, after starting the fire, hot water begins to circulate at once, but in steam heating, steam must be generated before the radiators become warm. Another advantage of hot water is that a moderate degree of heat is more easily maintained than with steam heating. The cost of installation for hot water heating is a trifle more on account of the increased size of all the radiators, but it requires less attention than hot air or steam heating and the fuel consumption is usually less.

Importance of Heating and Ventilation.—Heating and ventilation is so important that it has become a scientific profession and has been developed to a high degree. The general aim has been to provide systems of heating which were economical in operation, in first cost and in durability. To provide such systems for large buildings where the apparatus is cared for by an expert engineer has not been as difficult as to provide a similar apparatus for the dwelling. Here the labor involved does not warrant the employment of a skilled man to care for the apparatus unless a number of houses in a district are heated by one heating plant. In all houses where steam and hot water are used, which in themselves provide heat without ventilation, it is necessary to rely upon special devices for the admission of plenty of fresh air and for the expulsion of all foul air. In connection with heating, the amount of moisture in the air is important. The ratio of the amount contained

to that required to saturate the air at the temperature considered is called the relative humidity. If the relative humidity is low, evaporation will take place rapidly and the skin and membrane in the throat and nose will become dry, causing discomfort. Also, on account of this evaporation the body will become cooler. Too much moisture in the air causes the body to feel damp and even clammy. The usual amount of moisture for comfort should be such as to give a relative humidity of about 70 per cent.

The amount of pure, heated air of proper relative humidity required per person in a dwelling is approximately two thousand cubic feet each hour. The air of living rooms in use should be changed four times per hour, of kitchens and toilet rooms five times per hour, and of bedrooms, except at night, about once per hour. When no provision is made for ventilation, leakage of air will cause only about one-half of this change in atmosphere, consequently special provision for fresh air should always be made.

SKETCH PROBLEMS

- (1) Show by diagram a one-pipe system of steam heating.
- (2) Show by diagram a system of hot air heating.
- (3) Draw a radiator and explain how it is known to have a certain number of feet of radiating surface.

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CHAPTER XV. LIGHTING

LIGHT.—Light is a radiation that travels through the ether which pervades all space. There are many other forms of radiation in the ether, light being the one with certain wave lengths that affect the retina of the eye and produce the sensation known as "light." These wave lengths are a series, the shortest visible one being violet and the longest being red. White light is a sensation produced by a combination of all colors in the proportion as found in daylight.

Daylight.—The importance of good daylight in a dwelling can hardly be overestimated. Not only should good daylight reach all parts of a house but actual sunshine should enter each room for a part of the day. Kitchens and bedrooms especially ought to have sunshine. The importance of daylight lies both in its illuminating and health giving qualities. Where light and sunshine enter many pathogenic bacteria or disease germs cannot thrive. It is worthy of note that sleep is more refreshing and prolonged in the absence of light or in darkness. It follows that the two natural conditions of daylight and darkness should be utilized to the greatest extent possible by human beings in order to produce the maximum soundness of mind and body.

Windows are the chief source of light in our dwellings. These should be plentiful, not necessarily in the matter of numbers but in actual glass area. Having windows, it is necessary that they be not so screened and curtained as to eliminate the possibility of admission of light. Most

of the light enters from the upper part of the window opening which is the reason that school-room windows are placed near the ceiling. Light from the upper part of such a window reaches across the room while light from the lower part reaches only a few feet into the room. The ordinary window shade while sometimes useful in shutting out streaming sunlight is more often detrimental to the admission of good light. In general it should be kept rolled to the top of the window and not drawn halfway down.

Of the types of windows the casement or hinged window is best for lighting and incidentally for ventilation since when open the entire area of the wall occupied is available for the circulation of air. Window shades are not often hung over casement and French windows, and in fact it is impossible when the window opens into the room unless the shade is hung on the sash itself. A double hung or sliding window permits of only half the area being used for ventilation and on account of window shades, curtains and overhang the upper part admits but little light. However, double hung windows are otherwise very practical. Ceiling and skylights are useful in halls where windows are impossible and essential in studios where well diffused north light is desired. Skylights are made of translucent rather than transparent glass. To throw light into a dark passage from an end, prism glass may be used as in the upper parts of store fronts.

Artificial Light.—Artificial light has been used at all times. Probably the first device for light-

ing, after the camp-fire, was a torch made with a stick and a wad of pitch or grass. Next came the use of a wick in animal or vegetable oil contained in a vessel. Until almost recently tallow and wax candles were used, the feeble rays of light being harbored and protected from blasts to prevent them from flickering out. Kerosene lamps next came into use and are still of importance in isolated houses. The development of the kerosene or coal oil lamp was checked by the introduction of gas and, later, electricity as a means of lighting. By the use of the latter, night may be made nearly as light as day.

In artificial lighting, illumination is more important than brilliancy. Dazzling lights are of use only for effects. Very bright lights may give the impression of illumination without really lighting the room. If the parts of a room are well illuminated and no brilliant lights are in striking evidence the room is well lighted. The important consideration, then, is diffusion of light or the reduction of the intrinsic brilliancy of light. To accomplish this, shades and reflectors are used, but care must be exercised to prevent the wasting of light in the diffusion. Shades are made of ground or frosted glass, opal, or prism glass of some special design. Reflectors are of a vast number of makes and kinds all of which are in more or less common use. Indirect lighting is accomplished altogether by reflection.

Color of light is important. An imitation of daylight is of course best but difficult. For decorative effects soft yellow or red lights are cheerful. Violet rays have the general char-

acteristic of destructiveness and are not good in illumination. The arc lamp is violet or blue white in color. The natural predominant color in lights may be changed by the use of colored shades. Wall materials, their color and texture, have an important bearing on the lighting problem so that it is essential to take them into consideration. A color is carried by reflection of light to all parts of a room so that a glazed red paper would produce a glow of pink. In general, bright colors and glazed surfaces reflect much light, while sombre colors and dull surfaces reflect little light. Black velvet reflects practically no light at all, the light being absorbed.

The intensity of light is measured by a legal standard called the unit of intensity of light. It is that produced by the British standard candle weighing one-sixth of a pound burning at the rate of 120 grains per hour, and producing thereby one "candle power." A foot candle, or unit of intensity of illumination, is the illumination obtained on a surface one foot away from a source of light of one candle power when the surface is at right angles to the light ray. The amount of light necessary for a room depends upon the nature of the room. It is usually estimated in foot candles. The height of the ceiling, color and surface of the walls and ceilings, and other conditions must be taken into consideration. For dwellings the required intensity of illumination is from one to three foot candles. In general the characteristics of good lighting are efficiency, appearance, diffusion, uniformity, color value and eye protection.

Special light for certain occupations must, however, be provided.

Illuminating Gas.—There are five kinds of illuminating gas. They are coal gas, water gas, natural gas, gasoline gas and acetylene gas.

Coal gas is made by heating bituminous coal in air-tight chambers. It is the most common variety used for illumination in towns and cities. Water gas is made from anthracite coal and steam. This gas contains less carbon than coal gas and consequently does not give as much light although it is better for heating. When used for lighting purposes carbon is added by vaporizing petroleum and injecting it into the hot gas before it leaves the generator. Natural gas is obtained from drilled wells and furnishes a very economical system of lighting. Gasoline gas is a mixture of vaporized gasoline and air. It always is generated close to the burner rather than piped for a distance. Acetylene gas is described in the chapter on architectural appliances.

In piping a house for gas ordinary wrought iron pipe such as is used for water is satisfactory. All pipe to be used should be tested before being placed in position in order to insure against leakage. At turns, the pipe should not be bent but fittings should be used.

To insure an even flow of gas as well as a sufficient flow the diameters and lengths of the sections of pipe must be predetermined. Since the friction increases with the quantity of gas that flows through a pipe the size of the pipe must be greatest at the meter. The run of a three-eighths inch pipe may not be more than

DOMESTIC ARCHITECTURE

twenty feet; of a one-half inch pipe, thirty feet; of a three-quarter inch pipe, fifty feet; of a one-inch pipe, seventy feet, and of a one and one-quarter inch pipe, one hundred feet, providing that only one outlet is at the end of the pipe. For more outlets, the length of pipe may not be as great. In a house a three-eighths inch pipe is usually proper for a single outlet, but a riser from which several outlets are to be taken should never be less than a three-quarter inch pipe. A gas range requires a three-quarter inch pipe. The accompanying table shows the correct sizes of house pipes for different lengths of pipes and number of outlets.

NUMBER OF OUTLETS	LENGTH OF PIPES IN FEET								
	$\frac{3}{8}$ -in. Pipe	$\frac{1}{2}$ -in. Pipe	$\frac{3}{4}$ -in. Pipe	1-in. Pipe	1 $\frac{1}{4}$ -in. Pipe	1 $\frac{1}{2}$ -in. Pipe	2-in. Pipe	2 $\frac{1}{2}$ -in. Pipe	3-in. Pipe
1.....	20	30	50	70	100	150	200	300	400
2.....		27	50	70	100	150	200	300	400
3.....		12	50	70	100	150	200	300	400
4.....			50	70	100	150	200	300	400
5.....			33	70	100	150	200	300	400
6.....			24	70	100	150	200	300	400
8.....			13	50	100	150	200	300	400
10.....				35	100	150	200	300	400
13.....				21	60	150	200	300	400
15.....				16	45	120	200	300	400
20.....					27	65	200	300	400
25.....					17	42	175	300	400
30.....					12	30	120	300	400
35.....						22	90	270	400
40.....						17	70	210	400
45.....						13	55	165	400
50.....							45	135	330
65.....							27	80	200
75.....							20	60	150
100.....								33	80
125.....								22	50
150.....								15	35
175.....									28
200.....									21
225.....									17
250.....									14

Electricity.—Electricity appears to be either upon the surface of bodies as a charge or to flow through their substance as a current. The former is called static and the latter is called dynamic electricity. The branch of electrical science that treats of the action of electric currents is termed electro dynamics. Electricity is generally referred to as “flowing” through a circuit. For the sake of convenience it may be said that electricity flows from a higher potential to a lower potential. Therefore, when a difference of electrical potential exists between two points of a circuit it causes a flow. This difference of potential is electromotive force. The unit of electromotive force is the volt and the head or pressure that produces the current is the voltage. The quantity of current is measured in amperes. An ampere-hour represents an amount of electricity equal to one ampere flowing one hour. The term load refers to the current that is required. Resistance is the property that causes a body to oppose the free flow of electricity. The specific resistance of many materials is known. The unit of resistance is the ohm which is the resistance of a uniform column of mercury 106.3 centimeters long and 14.4521 grams in mass at the temperature of melting ice.

The unit of electrical work is the energy expended by one ampere in one second in overcoming the resistance of one ohm. This unit of energy is called the joule. The unit of electrical power is the watt being the joule per second. The watt is also called the volt-ampere; 1000 watts equals one kilowatt. The kilowatt-hour

DOMESTIC ARCHITECTURE

is the energy expended in one hour when the power is one kilowatt; 746 watts equals one horse-power.

Electric Lighting.—For supplying electrical energy to lamps several systems are employed. The direct-current, constant-potential system, may be from two-wire to seven-wire systems. The direct-current, constant-current, system, is used largely for municipal lighting. The alternating-current, constant-potential system, may be a single-phase, two-phase or three-phase system. The difference between a direct current and alternating current is that the former is uniform in strength and direction while the latter rapidly rises from zero to a maximum, falls to zero, reverses its direction, attains a maximum in a new direction and again returns to zero. The alternating current allows a greater simplicity in dynamos and motors, a facility for transforming from one voltage to another and other advantages.

Personal Hazard.—There is an element of danger in connection with operating electric lights and devices. The chief one is in turning on a lamp or a switch with wet fingers while one hand is in a basin of water. Another is in performing the same action from the bath tub. In all cases it is well to avoid handling electrical apparatus with wet hands or while standing on a wet floor, since water is a good conductor, and any fixture may be faulty.

Electric Wiring.—In brief, current for use in a house is brought from the wires of the lighting company which probably carry 220 volts. This

electric current is brought in by means of feed wires which should be in a non-conspicuous place. Just inside of the wall where they enter a main fuse block and switch should be installed. A distribution cabinet is placed near the centre of the building from which necessary circuits are provided for the house, each of which may be controlled by a switch in this cabinet. Each circuit carries 660 watts. In case of more than one story in the building a cabinet is placed on each floor and the circuits for that floor distributed from it. Thus all lights in a building may be controlled by switches in cut-out cabinets. A circuit usually comprises about 12 outlets and is used for a definite room or suite of rooms for the sake of convenience.

In general, electric wiring is installed either as a knob and tube system or a conduit system, all work being concealed. When wires are not confined within conduits or pipes they are simply fastened to the structural parts of the building by means of porcelain, glass, rubber and other insulating materials. All wires exposed to air and moisture must rely for protection upon their own insulation. Conduits are made of wrought iron pipes, flexible iron pipes, brass covered pipes, and woven insulated tubes. The function of the conduit is to carry electric wires and to protect them from mechanical injury and outside influences, as far as possible. In brick, tile and concrete construction it is customary to use a conduit system of wiring. In all high-class work a conduit system is far better than the common system. The greatest danger in

DOMESTIC ARCHITECTURE

connection with electric wiring is the accidental forming of "short circuits." This is most usually caused by wires having the insulation burned off and coming into contact. Unprotected wires becoming wet, water being an excellent electrical conductor, a current may pass from one wire to another by sparks, setting fire to any inflammable material which may be near. If the wires themselves are properly insulated and are also in conduits this danger is eliminated. Conduits extend not only the length of every wire in the building but are used in the form of boxes at junctions of wires, outlets and switches.

The National Board of Fire Underwriters have prepared a set of rules for the installation of all electric wiring and fixtures which is a recognized standard. To obtain insurance on a building it is necessary that the National electric code has been followed. Moreover, most of the towns and cities of the United States have adopted this code as a part of the building ordinances.

Switches.—The electric switch is a device for opening and closing a circuit supplying a current to an outlet or series of outlets. For controlling a lamp a switch is connected with a loop from the lamp and with the distributing or circuit wire. For controlling a series of lamps perhaps all in one large room a switch is cut into the circuit that feeds the lamps. The mechanism of switches is varied. For house use or for controlling the various lamps in the dwelling a push button switch set flush in the wall of the room is most satisfactory. For controlling a circuit

a double pole knife switch is commonly used, being placed in the cut-out cabinet. Switches may be one-way, three-way or four-way switches. A one-way switch is the ordinary appliance used to turn on or off the light from one point only, which point would be conveniently near the entrance door to the room. A three-way switch is an appliance whereby a light may be turned on upon entering one door of a room and turned off upon leaving the room through another door. Two three-way switches and intermediate four-way switches are commonly used on stairways, so that at any floor or landing the lights on the stairs may be controlled.

Circuit Breakers, Cut-Outs and Fuses.—These are the great safety devices in any system of wiring. Their object is to shut off electrical current from any part of the system when a dangerous amount of current passes through the wire. Circuit breakers are automatic switches used on switch boards in large installations to open circuits instantly and to take the place of fuses when the latter are not convenient or when the latter are subject to frequent renewals. A cut-out is a porcelain appliance with a fuse inserted between the ends of the wires used in the cut-out cabinet to protect a circuit. A fuse is any small piece of fusible material inserted in a wire which when overheated by a current melts away thereby breaking the circuit. Fuses, cut-outs and circuit breakers must necessarily be employed throughout an installation to protect every part and the whole of it. The ordinary fuse plug in common use when burned out by

accident such as overloading of wire may be readily replaced if a supply of fuses of proper capacity is always on hand. A very common cause of blowing out a fuse is the use of an instrument like an electric iron on an electric light outlet, this instrument consuming more power than the circuit is able to provide. A blow-out necessitates simply the insertion of a new plug which would cost probably five cents.

Lamps.—Lamps are of two kinds, arc and incandescent. Arc lamps are used mostly for exterior illumination. Incandescent lamps are of a number of varieties the principle of illumination being the heating of the small wire inside of the globe to a state of white heat or incandescence. These lamps have been developed remarkably of late and are now very economical of current. The old carbon incandescent lamps were not economical. Electric lamps are rated in watts or power consumption.

Incandescent lamps are connected to distribution wires in three ways: in series, in parallel and in parallel series. When lamps of a circuit are arranged one after another so that the current flows through all of them the lamps are in series. When the lamps of a circuit are arranged with two wires connecting with the wires of a circuit they are lamps in parallel. This is the common method of wiring and probably the best. Any one lamp may be controlled by a switch of its own, or the whole number on the circuit may be turned on or off at one time by the use of a knife switch. When the lamps of a circuit are arranged in sets on a wire between

the two wires of a circuit they are lamps in parallel series. This is simply a combination of the other two methods of wiring for lamps. A three-wire system is also in use.

Method of Calculation.—In electric lighting calculations, for the sake of convenience, the term “lumen” is used. A lumen is the quantity or flux of light necessary to produce one foot-candle average intensity of illumination over an area of one square foot. As an example, calculate the lighting for a dining room thirteen feet square and ten feet high. First, assume that the intensity of illumination should be 2 foot-candles for a dining room, the color of the walls and ceiling being dark. The area, 169 sq. ft., times 2 foot-candles equals 338. Assume that 60% of the light is absorbed by the reflector, walls and ceiling, leaving 40% of efficient light. Divide 338 by .40 to get the total light in lumens required. This will be 845 lumens, the quantity of light needed. The lumens of electric lamps are known so that it is comparatively easy to select lamps of certain wattage that will answer the purpose and to locate the fixtures where uniform light will be produced. An element to be taken into consideration in calculation is dust on lamps. Much dust may reduce the efficiency of a lamp 25%. All lamps and fixtures should be cleaned very often.

Methods of Illumination and Fixtures.—Lighting or illumination is accomplished by the direct method and by the indirect method. The former consists of illuminating the room by means of lamps with the lights diffused or re-

flected directly. The latter consists of concealing all the lamps behind solid or opaque reflectors but allowing light to shine upon the walls and ceilings from where it is reflected onto surfaces to be illuminated. Indirect lighting requires more electricity but produces a more satisfactory light than does direct lighting. The light is better diffused and consequently easier on the eyes. A combination of the two methods in house lighting is pleasing. Sometimes a fixture combines the two either by the use of an opaque bowl reflector or by having lamps on the under side of a bowl for direct lighting. Portable lamps used on a table must necessarily be for direct lighting but whether on a reading table, dining room table, or writing desk should never have the naked lights exposed to the eye. A shade or reflector is necessary. Reading lamps should of course focus intense but well diffused light. Dining room lamps should either be high over the table so as to throw light in a general manner or should be very low so as not to be an obstruction to the gaze. Lamps which of necessity must be in the line of vision should be enclosed with a globe and may diffuse soft colored light.

The materials used for fixtures by manufacturers is most varied. Every year new designs appear on the market. Selections of lighting fixtures is a matter of taste and discrimination. Only articles that will be of permanent wear should be used. They may be of iron, brass, bronze, glass or other materials. Plated ware is not desirable. The more simple designs are

best in that they are not tiresome and are easily kept clean. The lighting fixture should not be considered an ornament but a means of supporting lamps. The lamp itself may be either purposely ornamental or simply utilitarian.

SKETCH PROBLEMS

(1) Show by diagram how electric lamps may be placed on a circuit.

(2) Show by diagram a good arrangement of lamps in a familiar living room.

(3) Lay out a scheme of furnishing electric current to a residence for lighting purposes showing feed wires, meter, cut-out cabinet, distribution panels, and circuits.

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CHAPTER XVI. PLUMBING

INTRODUCTION.—Plumbing includes hot and cold water supply, drainage and sewage systems, incidental appliances of the same nature and sometimes gas fitting or piping for gas. Good plumbing depends largely upon the mechanic intrusted with the work of installation and upon the quality of materials used. It is necessary in the plumbing work of a residence to depend largely upon the plumber himself.

Water Supply.—Water is supplied to houses by pressure from a municipal or private water plant. Pipes employed for conveying cold water are usually made of wrought iron. Lead pipes were once used extensively. It has been ascertained that as a general average one person in a household consumes about twenty-five gallons of water each day. A horse or cow consumes about seven gallons a day and a carriage or machine requires ten to twenty gallons per day. Under certain conditions much more water will be consumed than here stated. Lawns and gardens may require a vast amount of water. It follows that the size of the pipe supplying the house must be sufficient to produce a strong flow so that when water is being drawn from a number of faucets at a time the flow from any faucet will not be materially diminished. In case of fire an especially strong flow of water may be found to be essential. The pressure and size of the pipe determine the flow of water. In high pressure water systems a one-half inch pipe may be large enough while in a low pressure system a one and one-half inch pipe may

be necessary. Low pressure means a pressure of less than twenty pounds per square inch. When the pressure is very low it may be necessary to provide a house tank, that is, a tank in the attic to receive a constant small stream of water and thus form a reservoir from which a large stream may be drawn at any time for a limited period or until the tank is nearly empty. The capacity of a house tank or storage tank should be 200 gallons. It should be constructed of sheet lead, galvanized iron or zinc as lining for a strong wooden tank. When city water pressure is very high, it may be necessary to reduce it before the water enters the house system on account of danger of breaking apparatus. Hot water is provided by a gravity system of waterflow in which water from the city supply or from a tank of soft water in the attic flows through the range or heater and is stored in a hot water tank. These systems vary somewhat, but it is important that the loop for circulation of water be so constructed that there is a constant flow from the boiler around the loop and back to the boiler regardless of whether or not hot water is being drawn off. In this method of construction, hot water continues to circulate even when the city water is turned off.

Water pipes should not be placed in outside walls where freezing is common unless the pipes are especially well protected. It often happens that plumbing fixtures are more convenient on outside walls so that it is necessary to take precautions against freezing.

Drainage.—Drainage means the conducting of rain water from the roof, surface water from the grounds and seepage water from the basement floor and other floors either above or below grade. Rain water may be conducted from the roof to a cistern and used for the house since in many localities city water is not suitable for washing purposes, being, like much well water, too hard. Water is conducted from a roof by means of a gutter at the eaves and down spouts leading to drain tiles beneath the surface of the ground. Gutters and down spouts are made of tin, copper or galvanized iron. Drain tile below grade are of the ordinary terra cotta tile. Where a cistern is used it is necessary to have a shut-off in order that excessive water may be turned from the cistern into the drain tile.

Drain tiles at the foot of the foundation wall should be provided to carry off the water that seeps through the soil thereby preventing the basement walls from absorbing moisture which would cause a damp cellar. At certain places in the basement, outlets for water should be provided to which tiles are joined all leading to the sewer or to the low point and natural drainage of the property. Laundries and bathrooms especially require floor drainage. Drain tiles leading to the sewer must be constructed with traps like that of the private sewer in order to prevent sewer gas from escaping back into the house. All parts of the grounds should be drained either by means of gradual slopes or by means of tile in order that rain water will quickly flow to its outlet. Depressions of any kind require

a special drainage treatment. Steep hills where water may flow in a small torrent on the surface very often require concrete boxes or catch basins into which the water may pour but be further conducted by means of tile. Such boxes should have a lid constructed of slats, a perforated board or an iron grating in order that rubbish may not fill the inside. A tile leading from this kind of box is not placed in the bottom because it is necessary that the silt be allowed to deposit there to keep the tile itself clear. This silt should be removed occasionally.

Sewers.—Ordinarily all liquid waste from a house is conducted to the public sewer by means of pipes. Pipes inside of the house are made of cast or wrought iron and fitted together by means of threads and sleeves in an air-tight manner. The pipes leading from sinks and lavatories are called waste pipes and are usually two inches in diameter. Those from water-closets are called soil pipes and are usually four inches in diameter. Iron pipes lead to a few feet outside of the basement wall where they are connected to vitrified tile laid together with cement mortar forming a continuous pipe leading to the street sewer. Certain precautions are necessary in plumbing installation to insure perfect sanitation and to prevent the entrance of sewer gas into the dwelling. To accomplish this a system of traps and vents has been invented and is required by practically every city building ordinance. A trap is a device which allows liquid to flow through it but prevents the passage of gas in either direction. The ordinary

trap consists of a downward crook in the waste or soil pipe which constantly holds water thereby forming what is called a water seal. Pressure of water from above forces the water contained in the trap on through the pipe but other water takes its place. A great pressure of air or gas may blow out a water seal but a trap is ordinarily not subjected to such pressure. On the under side of the trap a trap screw is invariably provided for cleaning out the pipe. Since all sewer pipes at times contain gas it is necessary to provide an outlet for it. This is accomplished by erecting a pipe called a vent stack from a point beneath the trap to a point above the roof. Gas then has a natural means of escape. Every plumbing fixture including water-closets, sinks and lavatories must be provided with a trap and a vent stack. Quite often the four-inch soil pipe is extended from the basement through the roof becoming in its upper extremity the vent. Each fixture with its trap is connected to it by means of two pipes, one for drainage and the other for ventilation. Traps are of a great many types all of which answer the same purpose.

Waste water from kitchen sinks usually contains grease which will eventually clog sewer pipes unless removed. Removal is accomplished by the construction of grease traps consisting of a basin made of lead or tile into which the waste water pours before entering the sewer. The pipe which carries the water from a grease trap is projected into the lower part of it since the grease itself always collects at the top of the pool.

The depth of the water is held constant at the horizontal line of the outlet pipe and the whole trap is ventilated like any other fixture.

Septic Tanks.—For an isolated house where a sewer is an impossibility it is necessary to provide a cesspool or septic tank with an absorption system, which should be located perhaps forty feet at least from the house and should accommodate only the sewage rather than the drainage water. A cesspool is simply an underground tank or cistern made of brick or plank set together in such a way that water may seep into the surrounding soil. It is essential therefore that the surrounding soil be porous, gravel being the most serviceable. A cesspool is only a temporary structure. As soon as it becomes full of solid matter it is cleaned out or abandoned and a new one built. It should be sufficiently below the surface to prevent the escape of gas. All gas formed should be conducted by means of a vent pipe to a high point above the roof of the dwelling. A very efficient way of taking care of sewage is by means of a septic tank made of concrete. Certain principles are involved in the destruction of waste matter and the carrying off of the harmless liquid resulting from the process. The sewage flows through a regular sewer pipe into a part of the septic tank which is air tight, where bacteria that thrive without the presence of free oxygen act upon the contents. From the first compartment the liquid flows into a second part, which is ventilated, where bacteria that thrive in the presence of oxygen act and thereby cause the liquid to be purified.

It is necessary that the surface of the water in the septic tank be not disturbed so that the system of flow of sewage is by means of siphons. For disposing of the liquid from a septic tank a set of tile pipes may carry it to a field where it performs a function of irrigation or with seepage water may be drained off by a tile or an open ditch.

Fixtures.—The materials employed for plumbing fixtures are marble, porcelain, vitreous ware, enameled iron, tile and soapstone. Originally marble was used most extensively but has come into disuse. Perhaps the best plumbing fixtures are now made out of porcelain. It is a hard impervious material, white or cream white in color and is of an attractive appearance in general. It is made in several grades, the best being very expensive. Vitreous ware resembles porcelain but is of a bluish white color. It costs about the same as the cheaper qualities of porcelain. Enameled iron for plumbing fixtures is cast iron enameled on the surface. It is used more extensively than any other material on account of its cheapness and durability. The chief drawback to the use of enameled iron in plumbing fixtures is the tendency of enamel to crack when exposed to undue heat. The best enameled iron is guaranteed to withstand sudden application of hot water. Tile is an elegant material for certain plumbing fixtures but requires skillful workmanship to produce satisfactory results. In the use of tile it is essential that the tile be impervious to water and that the cement used in laying the tile be durable. Soap-

stone is used especially for counters and sinks and is very practical.

Perhaps the most important plumbing fixture in a house is the water-closet. These are being improved year by year with the general tendency to obtain a fixture that is perfectly sanitary, convenient and noiseless. The manufacturers show very efficient models. The various parts of a water-closet should be so constructed as to be very plain and easily cleaned. Perhaps no one modern fixture is better in every respect than any other. The siphon type of closet in which the water enters at the rim above the bowl and the contents are siphoned out at the bottom in a noiseless manner is probably the best. Lavatories are of a large number of patterns, among which are the pedestal lavatory, the bracket lavatory and the built-in lavatory. Each may be of any material and of convenient size and shape to fit the space provided for it. Perhaps the lavatory set away from the wall on brackets with the pipes from the wall rather than from the floor is the most sanitary and the most easily kept clean.

Bath tubs are of three types, those with a base, those with four separate feet and those built into the wall or sometimes into an alcove. It is necessary that small spaces behind and beneath tubs be eliminated since they invariably collect dirt and are difficult of access. A model type of bath tub is one sunk in the floor of the bathroom and enclosed with a brass railing. Steps may lead into it at a convenient place. Such a bath tub may be made of any waterproof

material but is best made of glazed white tile. They are not as expensive as would seem at first thought and occupy very little more space than ordinary bath tubs. The main objection to them is the space occupied below the floor level.

Foot baths, infant baths, showers and other fixtures of many patterns are in the market from which very suitable bath equipment may be selected. The main considerations in regard to plumbing fixtures are to have them free from crevices, set well away from other materials which absorb moisture, and provided with backs to accommodate faucets.

Kitchen sinks and laundry tubs, like other plumbing fixtures, may be had in many designs. Perhaps the most practical kitchen sink is one of enameled iron rather than of a more expensive material. Also a kitchen sink incorporated in the kitchen counter provided with a back of its own is more convenient than the combination sink and drain boards provided by manufacturers. The question of kitchen sinks resolves itself into one of preference. Certain special sinks for the pantry and also slop sinks for use in general cleaning are found to be very convenient if space and money can be provided for them. Laundry tubs are made in convenient series of two or three trays. They also may be of porcelain, vitreous ware, enameled iron, soapstone or cement.

SKETCH PROBLEMS

- (1) Show by diagram the principle of ventilating any plumbing fixture.
- (2) Show by sketch how rain water flowing down the side of a gravel walk may be properly taken care of.
- (3) Design a model concrete septic tank.

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CHAPTER XVII. GARDENS AND GROUNDS

INTRODUCTION.—Architecture, landscape architecture and gardening are closely related. The treatment of a home grounds including the three should be harmonious. Although we may not name the style of our dwelling, certain architectural characteristics almost invariably suggest either formal or informal garden treatment. Ordinarily, in the case of American homes, formal treatment has a leaning to Colonial, French or Italian style, while informal treatment has a leaning to English. For the sake of convenience, and on account of common usage, these terms for styles may be employed.

Intimacy.—The great quality to be acquired in landscape gardening is intimacy. A garden must be not only attractive but compelling. The house should be concealed rather than revealed, and should become a part of an inviting landscape. To accomplish this end the garden must commence at the walls of the building with vines and shrubs, and the garden path must lead one from the door to pleasant retreats. It may here be said that environment has a direct influence on the mind and body, and that natural beauty at the threshold is an everlasting inspiration.

Character.—In the beginning, or when a site is in its natural condition, the prominent characteristic of that site should be emphasized in the final result of house and garden. If this characteristic is purposely destroyed or slighted,

DOMESTIC ARCHITECTURE

the product is very apt to be a misfit in the broad landscape, or at least will have the appearance of artificiality. In some cases, especially in suburban properties, the whole topography or lay of the land may be changed by grading, thereby establishing a new condition which may be pleasing. Whole hills have been washed down by hydraulic processes, forming roads and terraces, and buildings have been erected which were not only conveniently accessible, but which were well placed in a sort of artificial formality. Also dull sites have been made over by forming lakes and other features which produced a pleasing but artificial informality. These two landscape treatments are really extreme and costly, and do not compare with natural beauty.

Large grounds should be treated broadly and left untouched as far as possible. The treatment would consist chiefly of clearing the ground of undesirable brush and debris, and saving and improving the turf, trees and other natural assets. At proper places on the grounds, the flower garden, vegetable garden, orchard, outbuildings, and the special features should be intensively developed. In almost all cases a formal spot of garden is desirable, the exact nature of it depending upon the personal taste of the owner, the house, the soil and the climate. Climate is a highly important consideration in all landscape gardening, for self-evident reasons. The land of firs may not be treated like the land of palms.

Suburban grounds must necessarily be treated

in a smaller and more compact way than country grounds. Here the conditions are more varied than elsewhere, since lots may be very small indeed, or several acres in extent. The same general principles apply to all treatments.

The landscape gardening of farms is being developed slowly but steadily. The real farm, ranch or plantation, should be beautified by common sense methods. First of all, permanent trees, if not already present, should be set out as groves and windbreaks, and to form avenues where much used roads and lanes will always be located. A convenient working lay-out of the farm should be established, allowing free circulation for vehicles and the moving of live stock. The house should have a good background of trees, with open vistas to give views in all important directions. Windmills, out-buildings, and the dwelling itself may be screened with hardy vines to soften the bold lines. Homes in rocky and wooded parts of the country are not difficult to treat, but the prairie farmhouse requires much work and time to get a pleasing appearance.

Local Materials.—To receive full economic value of a suburban property, both in saving of money and in gaining artistic effect, no one thing is more important than the use of local materials such as stone, wood and top soil. The soil should always be preserved and improved, and when subjected to the strain of growing crops will absolutely require a fertilizer, according to agricultural principles. Field stone, boulders and quarried rock taken from the

ground should be utilized for building walls and walks. No material will look so well as local material applied on the premises. Logs and poles can be used, when there is a surplus of trees, for rustic work. Bridges constructed of stone or wood supplied on the ground cannot be surpassed, if well designed. The English cottager employs his materials in this way, as do many of the rural dwellers of the older states of the Union. Their places are often charming.

Utilities.—Outdoor utilities occur on every estate. The smallest cottage on the smallest lot will require a path or walk at least. Such homely utilities as clothes lines and driers may be erected and may be made attractive. Wood-houses and all more or less inconsequential outbuildings should be located where entirely convenient, and treated afterwards. Outbuildings may consist of servants' quarters, a stable, garage, or often a complete set of farm structures. They never need to be unattractive.

In recent years a garage with an automobile approach has become very common, so that it is either provided as a separate structure, or on the ground floor of the house proper. Occasionally on hill properties the garage consists of a cave or dug-out in a bank of earth, perhaps at the street level, and is reached from the house by means of a tunnel or pergola with steps at one or both ends.

Utilities may be such buildings as greenhouses, vegetable gardens, or poultry yards, but no matter what contrivances are required, all

should be placed according to conditions of actual use and lay of the land.

Drives and walks, or approaches, as they are termed architecturally, are essential. They should be placed in the direct but perhaps not absolutely straight line of communication between the objective points, as nearly as compatible with the topography of the land and other natural and artificial features. A possible exception to the principle of direct communication by means of paths and drives is the garden walk, which may form a geometrical pattern, or wind among trees and shrubs. Always a garden walk or path should continue in graceful lines indefinitely, or arrive at a certain interesting point. Never should it terminate suddenly at nothing in particular.

Material for drives and walks are of stone, brick, gravel, cinders, clay and concrete. Concrete is the most serviceable, but should not be used so boldly as commonly seen. It is good policy to use the least amount of concrete possible. Brick should be laid in cement mortar with a solid base of cinders or gravel to prevent the walk from settling and becoming overgrown with vegetation. Any walk or drive needs a good foundation. The more pleasing walks and drives are made of gravel, but these require considerable attention at all times. They should be made of sand, clay and gravel mixed, in order to insure a permanent and solid footing. Stone flagging makes excellent garden walks in vicinities where stone is plentiful. A very interesting walk for secondary purposes is made by the use

of stepping-stones. They look especially well in informal gardens. Stepping-stones should be twenty-two inches apart, set level with the turf, in order that a lawn mower may pass freely over them.

Steps have a fascination peculiar to themselves, when used in the open, but should occur only where necessary, and not in wild, natural gardens unless cut in outcropping stone or made of squared logs. Steps are necessary at a terrace, and should have flanking walls or balustrades to retain the earth. In long flights of steps it is usually best to maintain a certain width throughout, or, the flight may be wider at the bottom. A long flight should be a series of flights of perhaps seven steps each, to facilitate climbing. All garden and outdoor steps should be easy; that is, they should have about a thirteen-inch tread and a five-inch rise in order to make them most convenient and also agreeable to see.

A common mistake is made in having a small terrace at the front edge of a lawn, instead of a gradual slope down to the public sidewalk. This necessitates one or two steps at the end of the front walk which are not only awkward to use, but disagreeable to see. On practically level suburban lots it is far better for all lawns to slope gradually back from the city sidewalk, without a terrace. Besides helping the appearance of each lawn, the scheme improves the whole street. As stated before, steps are interesting, but should be dispensed with except where required.

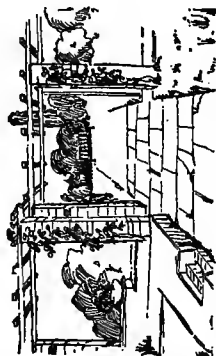
Games.—Tennis and other games requiring courts, fields or grounds of special construction should not be provided except in very large estates, because the sport is not of sufficient permanent or general importance to warrant the use of valuable garden or lawn space. A tennis court on a large site, although used for a comparatively short time each year for perhaps a period of years, may be made attractive by planting at the ends, behind the backstop. The proper upkeep of a court is difficult and requires much labor. A court in disuse is not pleasant to see.

Children's Pastimes.—Wherever children are to play, pastimes should be provided. These may be a sandbox, Flying Dutchman, swing, and other apparatus used in children's playgrounds. Rather than to set them at random on the lawn, it is better to fit them in snugly among trees, and have them a part of the general scheme. Children enjoy the feeling of security or protection provided by nooks in out of the way places, and seek them out of their own accord.

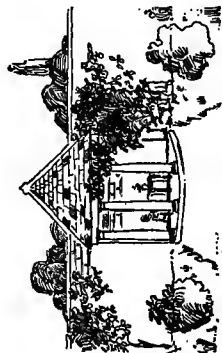
Ornamental Architectural Features.—Certain structures, although built for a purpose, may be said to be ornamental. These, above all other structures, should harmonize with the dwelling and echo its character. Some of them are really additions to the house, such as the pergola, which may extend from a porch to a garden removed some distance. The details of ornamental garden structures, or landscape architecture, require special attention on account of

the peculiar, intimate use of the buildings, and the outdoor livableness necessary to be imparted to them. The details must be such as to conform with big outdoor things, and yet be delicate enough to express refinement. (See Plate 45.)

Garden houses, tea houses, summer houses, and shelters are among the larger structures used in landscape work. Pavilions are also relatively large. They may be connected with the dwelling by the use of an arbor or a pergola, and should preferably be of the exact character of the main building, since they are in direct relation with it. A garden house, by its miniature size, gives dignity and scale to the dwelling. Garden houses are best placed at a point of vantage, that is at the hub of the garden, or at a high point commanding a view. Sometimes a small house built at the corner of masonry walls, overlooking a valley, is especially interesting. In this treatment the walls of the garden become two of the walls of the small house; but although in the case just mentioned the house walls extend above the garden walls and have openings in them on all sides, the house walls may be much lower, and open only on the garden side. This amounts to a summer house in the angle of the wall, with an approach from the garden. Occasionally a garden house may take on the form of a retreat or bower, but there must be more to it than simply a shady spot: interest is essential; either a distant view, a garden view, a vista or a stream of water. The bank of a creek or lake is an ideal place for a structure of this type, with a balcony overhanging



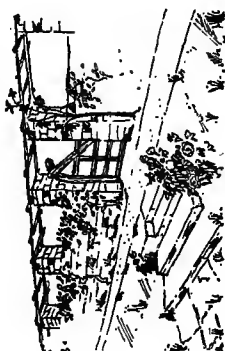
SEAT AT END OF VISTA



SHELTER



PERGOLA



GATE

Plate 45
GARDEN STRUCTURES

DOMESTIC ARCHITECTURE

the water or a rail at the common edge of bank and building. More formal garden houses, or tea houses as they are sometimes called, may be built on the far side of a large terrace which is on the garden side of the dwelling. Exceptions to the principle of having all structures on a ground of the same character may be made in the case of isolated garden houses. These may be of rustic design, either in stone or wood, if the environment strongly suggests it.

Pergolas seem to have originated in Italy, where they were used especially for grapes. Now they are used almost everywhere, with the same idea of growing vines of some sort over them. The growth is essential to the success of the structure. Primarily, a pergola should lead to a definite thing or place, and thereby be a connecting link between two points, one of which should be a terminal or stopping place. For instance, a pergola may lead from the dwelling to the garden house, or from the garden house to the rose garden, with perhaps a gate at the end. Sometimes a seat, statue or sundial is of sufficient value in the garden scheme to be the terminal.

Pergolas consist of posts made either of wood or masonry, set in double rows to support overhead beams. An arbor is of the same construction, but usually much more frail or light in construction. The overhead beams should be of sufficient size and number to carry the particular kind of vine contemplated for use. Pergolas are designed for the most part to support such foliage vines as the grape or Virginia creeper,

and such flowering vines as wistaria, clematis, and climbing roses. The old-fashioned arbor looks best as a bower or mass of foliage and flowers. In regard to forms for pergolas, they should preferably be straight and on level ground, but may be gracefully curved or stepped down with terraces. Always they should be of ample height and breadth for actual use. For Italian and Colonial gardens the posts of pergolas are usually white classic columns of wood or stone and have sawed beams overhead. Again the material employed depends upon the character of the dwelling. Piers of stone, brick or plaster, and squared posts of wood are used in the construction, but the beams are in most instances of wood for practical reasons. Rustic pergolas made of the trunks of trees or natural wood posts and poles for beams are very attractive, and may be of oak, cedar or other wood. For preserving posts set in the ground, the best method is charring the ends to go below the grade. The pergola, as an ornamental structure and a useful adjunct of the house and garden, is highly satisfactory.

Statues, sundials and fountains belong rather to the large, formal garden than to the small informal. Such ornaments, if used, must be of best design and material; that is, of marble or stone, and of distinctive character. Statues in gardens should be small and the subject simple. Peter Pan, Cupids, fairies, boys and grotesques are allowable. Grotesque statues and gargoyles in sculpture are very interesting. Statuary should be given a background of

DOMESTIC ARCHITECTURE

foliage in the form of a niche. Sundials are more desirable than statues as garden ornaments, and instead of occupying niches usually should be placed centrally or at intersections of walks. They should be of stone, and modest in design. Invariably a base should be provided to give the sundial a substantial appearance. Fountains are of a great many kinds. The more simple are very desirable as focal features in gardens and as points of interest in walls of masonry. A well with a bucket or a handle pump is always fascinating. Closely related to statues, sundials and fountains are vases and urns. These may be used quite generally, but should not be overconspicuous. Perhaps pottery or terra cotta is the best material for them. Tubs and boxes, if properly used, are desirable and useful garden fixtures.

Seats are the most intimate of all structures used in the garden, and most homelike. The humblest garden may well have a seat. A seat in a niche, with a vine behind and the boughs of a tree overhead constitute a garden. The two essentials in locating a seat are a background to give the feeling of security, and a foreground to hold the attention. Seats should not be placed in uninviting or isolated spots, or out in the open. Simplicity in design of garden seats is necessary, whether they are constructed of wood, stone or other material. To withstand the ravages of weather, they must be substantial in every respect.

Walls may be used to enclose a garden, or to retain a bank of earth. They are very attrac-

tive when built of rough stone or brick, with the mortar joints raked out and the surface covered with moss and vines. Their attractiveness lies in their ruggedness and durability, and in the mass of bright foliage displayed over the dull tone of their material.

Fences, gates and turnstiles are not the least important of garden structures, and on account of their unpretentiousness are highly desirable. What is more suggestive of domesticity than a white picket fence and a gate with a bucket of stones on a chain to pull it to? Although these suggest domesticity, the origin is quite different, and even the present use. They were once a means of protection as the gate, gate house, drawbridge and moat comprising the entrance fortification of a castle. At the present time a fence is for the purpose of keeping out invaders, either mild or vicious, and the gate or stile is a legitimate means of getting through the fence. Used ornamentally, they mark an entrance or become a focus at the end of a drive or walk.

Gates and stiles, both turnstiles and step stiles, when used on unpretentious grounds, should be of wood and may be of rustic or sawed timber construction. Gates may be used singly or in pairs. As with seats, the design should be simple. Wrought iron gates are most often used in connection with iron fences and brick or stone walls. They present an appearance decidedly pleasing when artistically designed, and are very durable if kept painted. A gateway may be simply an opening between two posts, but really suggests a gate. Steps leading to a gate

or gateway add a charm, especially if a vista beyond leads to an interesting termination. Where especially direct, pleasing vistas exist, it is well not to make the gate so heavy in design as to form a screen shutting off the view.

Water in the Garden.—A low spot on an estate suggests the possibility of having a lake, pond or perhaps a water or bog garden. Sometimes grounds have the advantage of a spring or flowing creek, or even a river. Water in the garden opens up great possibilities in the treatment of the whole, since green and growing things seem to be on especially familiar terms with water. It has been said that "fountains and waters are the soul of gardens," since they enliven and revive them. Perhaps the great attractiveness of a body of water or even of a stream lies not only in the freshness imparted by it, but also in the many sounds emanating, and in the reflections cast. A vast number of water treatments are possible, both formal and informal. Extreme treatments are best; that is, a formal fountain or pond should be very formally contained within its confines of masonry, and a natural creek or lake should be left absolutely in its natural condition. Water should be kept in motion, and debris causing contamination should be eliminated.

Water and bog gardens are somewhat of an exception to other water treatments, in that stagnant water is for the most part necessary for the growth of water lilies and bog plants. A bog garden may be a menace on account of mosquitoes and the tendency of the water to become foul.

No body of water, however small, should be allowed to remain absolutely stagnant and wherever bog gardens are located they must be well isolated from houses. Ordinarily such a garden is made in a bayou or sheltered bay of a creek, and is especially attractive in connection with a rock garden.

Rock Gardens.—In natural rock localities, or even in places where stone would not look out of place, rock gardens may be established. These are made by laying or rearranging rock in such a fashion as to imitate natural strata, with winding paths and plantings of rock plants, called Alpines. For satisfactory results and permanent life in a rock garden it is necessary that the soil between the rocks be suitable. It should consist of sand, leaf mould and other fertilizer, and should be well worked and tended at the time of constructing the garden.

Japanese Gardens.—A Japanese garden as adapted from the original consists of a miniature lay-out of ponds, paths, bridges and other landscape features. The scale should be sufficient to allow a person to conveniently pass through the garden, but it should suggest unmistakable miniatureness. A Japanese garden should be tucked into a snug place, and cut off from the natural environment by means of dense foliage, thereby causing isolation which is essential to the scale or size of it. Gardens of this type may be used on very small lots where there is not room for a general treatment. The important consideration in constructing a Japanese garden is the relation of one small part to another, since to

prevent incongruity it is necessary that each part be in scale with others.

Lawns.—Perhaps the most important feature of landscape gardening is the most simple,—the lawn. Lawns should be as far as possible in unbroken stretches and expanses, with gentle slopes to carry off surface water and to give the impression of naturalness. Never should a lawn be interspersed with shrubs or flower beds, but may have shade trees with branches trimmed high located by design or by accident. A good lawn is acquired only after a number of years of development, beginning with proper drainage, rich soil and painstaking cultivation. The care of a lawn is an important subject in itself.

Trees.—Trees hold a place of affection in the minds of all, and properly determine whether or not a place is inviting. Perhaps the great quality of trees in this consideration is their air of friendliness, since shade is at times a grateful relief. The best tree is the local tree, and a natural grove excels an artificial one. Trees should at all times be protected from natural loss and from wilful extermination, since a tree once destroyed is difficult of replacement. Trees, then, are the great essential adjunct of houses. Preferably, however, trees of large size should be at a sufficient distance from the house so that their shade will not fall upon the roof of it.

Shrubs.—The function of shrubs appears to be that of forming a softening line between ground and buildings, and between pavements and turf, and between other unlike and perhaps difficult matters. Therefore shrubs should be planted at

the base of walls or along the edge of walks and driveways, in order that they may perform their function. The size and natural characteristics of shrubs is important in locating them in certain places. Ordinarily the full grown shrub in combination with others should form a gradation in size or color or perhaps in both, so as to un-abruptly arrive at each of all masses which the growth is designed to harmonize or hold together. Conventionally trimmed shrubs and trees are out of place in any garden.

Flowers.—Flowers, always held in great esteem, serve a definite purpose in landscape treatment. The many uses of them are well known, among which are beds, borders and coverings for wall surfaces. Their method of growth, time of bloom and other traits must be carefully considered by the gardener. They serve as the ultimate refinement for the home grounds.

SKETCH PROBLEMS

- (1) Sketch a pergola in perspective.
- (2) Draw a sundial.
- (3) Sketch a shade tree and a garden seat.

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CHAPTER XVIII. GARDEN DESIGN AND CONSTRUCTION

I**NTRODUCTION.**—In the actual laying out of a garden, whether done by a landscape architect, a gardener or the owner, a certain method of procedure employing drawings has been found to be necessary in order to gain the most satisfactory results. Even though the garden be very small indeed a similar procedure is advantageous. It is best to actually make the various drawings here described, but for very small garden plots the principles of design and construction may be borne in mind and the work carried on with perhaps only small sketches as a guide. Ordinarily, a survey of the plot, shown by a topographical map, a sketch plan of the garden as it is to be, a grading plan showing where and how the earth's surface is to be graded, and a planting plan showing the location and variety of all plants to be used are essential in the laying out of a large garden or grounds. When buildings are not yet upon the site they should be located on the preliminary sketches and constructed exactly where shown, in order to have a wholly harmonious garden. When buildings are already upon the site the garden must necessarily be built around them.

Survey.—A survey is made with the aid of instruments to determine the property lines, the angles formed at the corners, the exact elevation of all parts of the lot which may vary considerably and the location of all objects such as buildings, trees, posts and other natural and

DOMESTIC ARCHITECTURE

artificial features. In making a survey the record or information gained is set down in tabulated form and is later plotted according to a scale graduated on a decimal system, that is, each inch representing 10, 20, 30, 40, 50, 60, 70, 80 or 100 feet. The survey of any property to be used as a home site is important in that it positively describes the property of the owner. Since it shows the exact physical conditions of the lot, it is used as a base upon which to design or lay out the grounds.

Topographical Drawings.—Although the plot of a survey may show only the boundary lines of the lot and the angles formed, a topographical map shows all of the features of the property or is made up from the data obtained from the survey. A contour or profile is a cross-section of the property on any given line and shows positively the elevation of the ground upon that line. The purpose of a contour or profile map is to determine in what direction the water flows naturally for drainage purposes and to determine the amount of excavation of earth necessary in changing the natural grade to the finished grade required in the laying out of the garden. For instance, if it is desired to build a terrace on the side of a hill, it would be necessary to draw one or more contour maps of that hill, and also the finished terrace to be cut into the hill, and thus to equalize the natural and artificial conditions so that no unnecessary moving and hauling away of earth would be necessary. In other words, the finished condition of a garden should represent, if possible, the same amount of earth

that was upon the lot originally, and should necessitate the minimum removing and replacing of earth or soil. In regard to the term "elevation" the word means the distance of a certain point on the ground above or below some other established point whose distance above sea level is known. This known elevation is called "datum," which in the scheme of measurement of elevations is called 0 feet. All distances above datum are plus (+) a certain number of feet and all distances below datum are minus (—) a certain number of feet. Quite often datum represents the level of the sea. The exact elevation of datum is defined in each locality. On topographical maps various features are indicated by conventional signs that are established and adopted as a standard system. By observing these signs all the features indicated on a map may be understood without special description.

Garden Design.—To design a garden or grounds of more than a tiny plot, a topographical map showing the present condition of the property should be at hand. Upon the lot all required buildings should be laid out according to the contour of the land and with the idea of preserving the natural advantages of the site. Approach and view are perhaps the vital considerations. The flow of water is one of the important points, since it is necessary to provide drainage and outlets for every part of the property. A site on the side of a steep hill requires special construction for preventing surface water from flowing down the hill in small torrents and washing with it the soil of the garden. Retaining walls,

DOMESTIC ARCHITECTURE

underground tiles, gutters or other devices are here necessary. It is highly important that all the drainage water be conducted away from the dwelling since a basement is like a well, and attracts seepage water. Slopes of lawns and terraces should not be made so steep that water will wash out small gullies in the soil. The nature of the soil itself has much to do with this tendency. Perhaps the ordinary angle for terrace slopes is three feet of rise to five feet of run. This is a convenient slope, since to climb it by a flight of steps requires six risers of six inches each and five treads of twelve inches each. Lawns should be given mild or easy slopes rather than steep slopes unless physically impossible. Driveways and walks should never be steep, the more nearly level the better. In gravel walks and drives especially, rain water tends to wash out small ruts, which eventually ruins the surface.

After the buildings are located, bearing in mind, of course, the approach, the view, and the garden features that are to follow, circulation or means of reaching all parts of the grounds conveniently must be provided. Circulation is brought about by the use of drives and walks which enter at certain convenient places, and lead directly to certain other places or wind in such a manner as to provide an outlet. It is usually essential to provide a driveway, a front walk and a tradesmen's entrance. The location of these depends entirely upon the site. The main walks and the drives should preferably follow along the edges of the property rather

than cut through the centre of broad open spaces, but only to the degree of reaching the desired point without leading far out of the direct route. This in most cases would be accomplished by a graceful curve, avoiding the open space by gradually swinging in to the dwelling. Drives and walks invariably look better when they appear to creep along the base of a wall, fence or dense growth, or wind among trees, than when they strike boldly through the open. As to exceptions, it is a question whether a front walk leading from the street in a straight line to the front entrance is better than a front walk which enters at a less conspicuous point and approaches the entrance more obscurely. Perhaps the solution lies in the general aspect of the house and grounds desired. The most formal treatment permits the use of the direct approach. In the majority of cases, however, the less conspicuous approach is best. The formal approach is used for pretentious and public buildings, and, in connection with long tree-lined avenues, is very effective for country homes.

All of the useful and ornamental structures of a garden should be pulled together and made into a unit by the use of paths, vistas, hedges, fences and plantings of various kinds. The formal spot, usually desirable, may be a flower garden of geometrical lay-out, a fountain and walks or other unpretentious design of some sort. The reason or the necessity of a small or large formal spot in the grounds seems to lie in the fact that an intensive development somewhere appears to be required to show the human ele-

DOMESTIC ARCHITECTURE

ment of gardens and to give to its whole composition the quality of scale or proportion. The small spot highly cultivated and showing evidence of skillful work with the hands brings the idea of personality into the general scheme of things. This truth is exemplified when the lack of personality is noted in the observance of large public parks of natural beauty, and even in large formal city parks where floriculture is practiced on the grand scale. On drawings of home grounds the small geometrical or formal garden spot seems to be necessary to give to the sketch that peculiar interest obtained by accenting a small part which holds the attention. To the trained eye, that which is fascinating in a design worked out on paper is also fascinating in the executed design or the real object. (See Plate 47.)

In garden designing after the buildings and all other features are indicated where they seem to be of greatest importance from the standpoint of utility and beauty, the harsh lines are softened by plantings. This is to say that in nooks and corners, along the sides of the approaches and against the building, and also in the spaces left for beds, vines, shrubs and flowers are placed. In more roomy places, if trees are not already present they should be discriminately used. Trees should frame a house and should form a background for it but should not enclose it. It is necessary that views outward from the house be provided and that glimpses inward be left for observers.

In general, garden designing consists of mak-

ing over in as moderate a degree as possible the natural conditions employing local materials as far as possible and embellishing the whole with beauty which is really artificial but appears to be natural. As in all composition, the well-known elements of design must be considered. The effects should be simple and harmonious and the various parts must constitute one pleasing unit. (See Plate 46.)

Grading.—Assuming that a garden is to be constructed according to a preconceived plan which has been set down, the soil would be graded exactly according to the elevations indicated on a grading plan. This drawing would have indicated upon it the original elevations of the ground and the finished elevations, represented in such a way as to readily show the amount of excavation and fill of earth needed in each and every part. No natural asset of the property, such as trees, rocks and water must be damaged during the process of grading. Top soil which is valuable for growing purposes must be preserved for distribution at the finish of the grading process. First of all the large masses of earth to be moved should be handled as cheaply as possible by the use of heavy machinery. When the site begins to assume its general finished appearance, stakes should be driven into the soil in such a way that the top of each stake marks the grade to which that particular part of the ground is to be brought. The grading should then proceed carefully until all parts are properly made. Where drives and walks are to be placed a small excavation of

perhaps six or eight inches should be left. Much work by hand is necessary in the finishing of a grading project, in order to secure perfect contours and perfect distribution of top soil. Grading, except for general distribution of excavated earth from the basement of structures is not begun until all buildings of the premises have been erected. In order to test the grading of a garden site it is well to wait for a heavy rain or apply water artificially to determine its flow, or a surveyor's level may be employed as a means of checking the work to find out any imperfections in grading. No sinkage should be left without a special drain.

Planting.—The selection of species and the planting of trees, shrubs, vines and flowers is the work of a landscape gardener. So complex and so varied are the conditions pertaining to the subject that only general considerations may here be mentioned. Flowers are classified according to their characteristics, usually as annuals whose life from the seed is one year, biennials, whose life from the seed is two years, and hardy perennials whose life from the seed is more than two years, or permanent. In selection of plants for certain purposes it is the ultimate growth of the plant rather than the size at the time of planting that is important, and the time of blooming and the color of blooms and foliage. The harmony of plants and the contrast of certain plants as well as the rotation of blooms and foliage throughout the season are important factors in selection of plants for use.

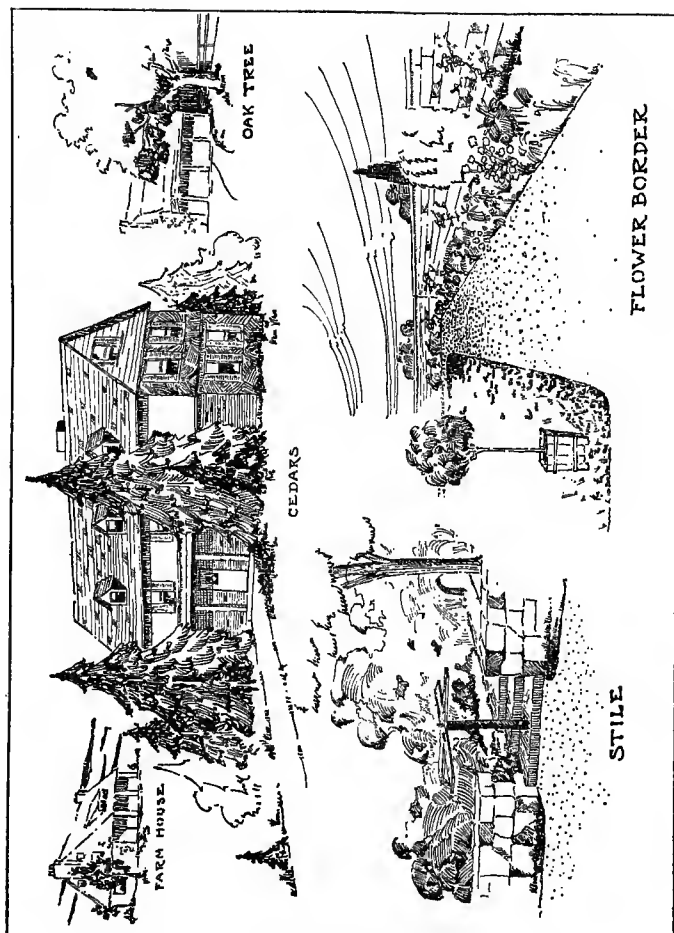


Plate 46
MISCELLANEOUS GARDEN FEATURES

Trees.—Trees require a great many years to reach maturity. The favorite shade trees of America are the oak, especially the white oak, hard maple, and the elm. Other trees make beautiful lawn and garden trees, but do not hold the universal, great regard given to the ones named. The life of a good hard-wood tree is ordinarily a hundred years or more. Certain trees of the forest have been found to be several thousand years old. Quite often shade trees are killed by improper usage. They require attention in order that they may thrive. Earth must cover the roots at all times, but not be heaped up around the trunk. Constant tramping of feet at the base of a tree, as well as rubbing and breaking of the bark, will eventually kill the tree. In setting out shade trees it is well to use as large a tree or sapling as possible, in order to save several years' growth. For planting trees it is well to employ an expert.

Among the beautiful garden trees are the beech, birch, catalpa, cedar, chestnut, linden, locust, magnolia, mulberry, pine, sycamore, thorn, tulip, walnut and willow.

Shrubs and Hardy Vines.—For foundation planting and boundary planting, there are a large number of shrubs and vines from which plants may be selected. A previously designed planting plan should indicate the variety, number and location of all plants to be used to produce in the end a permanent growth and a color scheme dependent upon the color and season of foliage, blooms and berries. Vines occupy the position nearest the wall, fence, or trellis, and

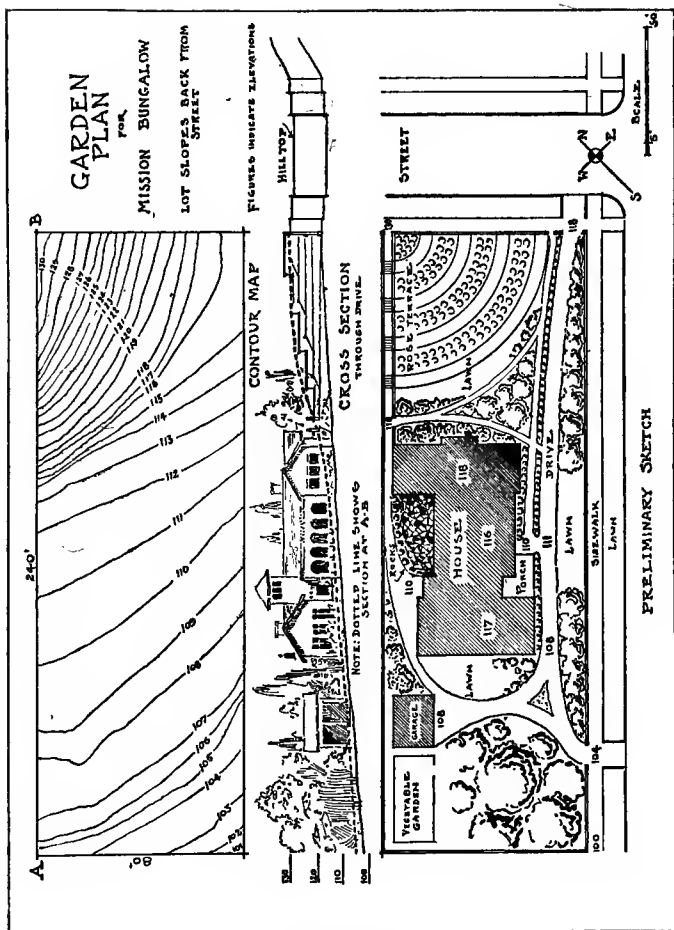


Plate 47
LAY-OUT OF A SUBURBAN GROUNDS

DOMESTIC ARCHITECTURE

should be given full opportunity to develop before shrubbery destroys them.

Among the permanent vines, blooming in the order here listed, are the following: wistaria, wild grape, climbing roses, trumpet creeper, clematis, Virginia creeper, ivy, evergreen bitter-sweet and myrtle. The characteristics of these vines are listed in many places where the subject is thoroughly discussed.

The shrubs are almost innumerable. For northern exposure dogwood, sumach, common elder, wild black currant, blueberry, and nanny berry are good growers. Shrubs that grow rather high are common elder, high bush blueberry, arrow wood, high bush cranberry, redbud, winterberry and black haw. Shrubs that are prickly and are therefore good for hedges and for nesting of birds are prickly ash, certain kinds of roses, cat briar, and low running blackberry. For feeding birds some shrubs are very useful. Among these are dogwood, sumach, June berry, spice bush and black currant.

Flowers.—Borders along paths and drives may be preferably of small shrubs, or may be of annuals, biennials and perennials. Very often mixed plants are best. Each of the little garden flowers known to everyone has a place where it may profitably and pleasurably be grown. Perhaps the two most agreeable little annuals, one for beds and borders, the other for climbing purposes, are nasturtiums and sweet peas.

Early spring flowers, especially bulbous plants, may be allowed to grow in the lawn, since after

DOMESTIC ARCHITECTURE

they bloom they are no longer seen. Carnations and many other kinds of flowers that are usually considered to be cut flowers may be raised in a very small glass covered sun garden or a small greenhouse.

Conclusion.—In general, a grounds planted with hardy vines and shrubs that require little attention and grow informally, is more pleasing and more satisfactory than a grounds in which it is necessary to keep up flower beds, and to re-plant and transplant continually. There is also more satisfaction in awaiting the turn of growth and bloom of each kind of plant in the garden, since year after year it makes its appearance for a while and gradually gives way to a variety that may follow it. Hedges require constant pruning and produce a rather formal appearance. All in all, plants should grow to their natural size and live on without more interference than is absolutely necessary.

SKETCH PROBLEMS

(1) Assume a suburban home grounds one hundred feet square with streets on two sides and a house forty feet square in the exact centre of it. The house is of an old-fashioned or Colonial type with a hall through the centre. Add new porches to the building and lay out a sketch plan of the grounds showing garden treatment at the scale of 1"=20' 0."

It may be further assumed that the grounds are level and that there is nothing whatever upon the site other than the house.

(2) Re-design a grounds with which you are especially familiar showing drive, walks, and plantings as they should be. Use very small scale.

(3) Lay out an old-fashioned flower garden assuming a small plot before the door of a Colonial cottage.

REFERENCES

Same as given at end of Chapter XVII.

CHAPTER XIX. THE ENGLISH IDEA OF SMALL HOUSES

INTRODUCTION.—English people are more economical than are Americans in every respect except in that of labor. In their domestic architecture the fact is exemplified. Instead of designing a house so that the work of housekeeping may be reduced to the minimum, they make little effort to secure convenience. With them it does not seem necessary to save steps, because manual labor is plentiful and cheap. Even a family in very modest circumstances can afford at least one domestic. The arrangement of the rooms of a typical cottage will show the result of this economic condition. In regard to compactness of plan, the use of materials and equipment of buildings, great economy is manifest. Since fuel is dear, special care is taken to construct the house so that it will be warm, and to arrange the fireplaces, chimneys and other details pertaining to heating so that the greatest benefit with the least consumption of fuel will be attained.

In England the small house is called a cottage, and although some rather large country houses are called cottages, the term really applies to the workman's cottage, the middle class cottage, and the "week-end" cottage. Workmen's cottages are usually built in blocks of from two to twenty, more often of from two to four. By this arrangement outside wall construction is reduced, and consequently the building cost is less. Workmen's cottages usually consist of only two or

three rooms on the ground floor, and one or two on the upper floor. Ordinarily there is no basement, hall, vestibule or porch.

On small places or "holdings" middle class cottages may have as many as ten rooms, perhaps six on the ground floor and four in the attic. The term "first floor" is not used by the English, except sometimes as the first floor over the ground floor. The "week-end" cottage is usually a cottage in the country made over to meet the requirements of the owner, who with family or friends comes for a few days at a time for an outing. This type of country place is not very popular with the Englishman, because of the inconvenience usually attendant upon the trip to it, because of the lack of comfort while there, and because of the lack of service, it being difficult to maintain domestics in such an isolated and seldom used house.

Ordinarily the "week-end" cottage consists of a very large living room, and small service rooms, with sleeping chambers above, and a verandah at the sunny side of the living room. Some country places of this type are liberally equipped with servants' quarters, a stable, a garage, a lodge, and other buildings, but under these circumstances the term "cottage" can no longer be aptly applied.

Arrangements of Middle Class Cottages.—In the matter of actual use the middle class cottage of England more nearly resembles the American suburban house than any other type. For that reason the arrangement is interesting

DOMESTIC ARCHITECTURE

to us. A small cottage may contain a living room, a kitchen, a scullery, coals, a larder, and a stairway leading to the bedrooms in the second story. A large cottage may contain a hall, drawing room, sitting room, dining room, butler's pantry, rear hall, servants' sitting room, kitchen, scullery, coals, larder, store, and a stairway to bedrooms and bath above. The main difference between the English cottage and our suburban house is quite often in the great distance in the former between the kitchen and the dining room. In the front part of the house may be the living apartments consisting only of a hall, a parlor and a dining room, while removed from them by means of a long service hall and pantry is the kitchen with a scullery and other accessories behind. There is an advantage in having the culinary operations carried on at a distance from the living apartments, but in order to serve a meal in the dining room, several servants are necessary. The English arrangement of rooms is from the standpoint of comfort almost exclusively. (See Plate 49.)

In the large cottages, a development of the early Tudor house is quite marked, one room being added to another, disregarding symmetry of plan. A very livable and picturesque house is thereby obtained. Doors and windows are placed where most serviceable, fireplaces are located out of the line of travel, and drafts are avoided. In spite of the informality of plan, some houses have a formal aspect upon entering the hall, especially those that have a drawing room or parlor for receiving guests. Dining

rooms quite often have adjuncts such as smoking rooms, billiard rooms and wine cellars. In most houses where the proprietor is a professional man, the office or study is located conveniently near the hall, or has a special entrance for it. English kitchens are used for preparing foods and cooking them; the cleaning is done in the scullery. Always a larder for the storage of perishable food stuffs is provided, and usually a store for shelving dry food stuffs. A very good arrangement is in having a "pent shelter" or back porch at the rear of the scullery, from which a water-closet is reached. In almost all cottage establishments, a walled or fenced yard is provided at the rear for general utilitarian purposes, and on some "holdings" a covered way leads to the outbuildings such as "roosts," "cow byres," "piggeries" and other structures. (See Plate 49.)

Appliances and Built-in Features.—English cottages are not well equipped with heating, plumbing and lighting apparatus except in a few instances. However, in recent years the American methods of equipment have been used. Most of the cottages are heated by means of fireplaces, each room having a grate. In small cottages the chimney stack is placed in the centre of the building and all flues are enclosed within it. Thus the chimney itself helps to warm the house. Fireplaces are used for ventilation, which consideration is very important to the Englishman. A room not having a fireplace must have other special ventilator. Coal, peat and charcoal are used for fuel, but

DOMESTIC ARCHITECTURE

since these are high in price, it is necessary to be economical in the use of them.

Although some cottages are well provided with bath, modern plumbing and lighting fixtures, the majority of them, especially the isolated ones, use makeshift appliances. A very interesting contrivance for bathing or taking the "weekly tub" consists of a sinkage in the scullery floor with a trapdoor to cover it. After a bath the door is used to stand upon, and is a draining board. Such a bath is placed in front of the cooking stove or near a "copper," where water may be conveniently heated. The fuel used to heat the water also heats the room. Portable baths are also used, which when not in use before the fire are stowed away in a closet. The better middle class cottages have a bathroom on the upper floor containing a tub and lavatory.

Built-in furniture is used rather extensively. One of the most picturesque "fitments" is the old-fashioned bench used often in chimney corners. It has a high back and ends or "draft wings" to insure comfort for the occupant. Tables and seats built against the wall are common, and "parlor dressers" or "consoles" are seen in many old cottages. Wainscotings and beamed ceilings are everywhere in evidence, usually of oak or dark stained wood, as the other trim. The most common feature in the English cottage is the bay window, which may be of any shape. This detail in most cases is very picturesque and useful as well. *Ingle nooks* containing the fireplace are quite common, and it may be mentioned that niches are usually pro-

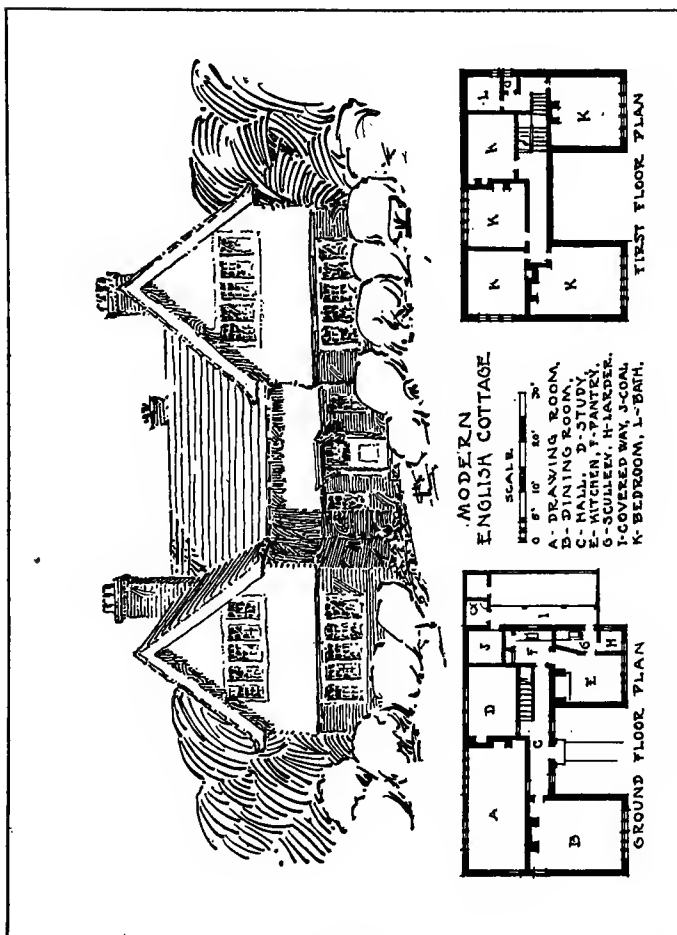


Plate 49
TYPICAL ENGLISH COTTAGE

vided to accommodate the cook stove, allowing a brick or tile hearth in front of it.

Cottage windows are of the casement variety almost exclusively, and very often arranged in groups of three or more with only narrow mullions between. The appearance is exceptionally good. Instead of putting a wood trim or casing around the window opening, the jambs in many cases are of plaster with splayed or beveled face. The reveal or thickness of wall not used by the window frame may be on the inside instead of the outside of the wall. Wood stools or "window boards" are very often provided on the interior for plants. The doors used in English cottages are very interesting, being constructed individually for the most part, of boards or battens, and are not of the stock variety of paneled door. These "ledged doors" are very serviceable. Staircases frequently ascend behind the living room fireplace, especially in old-fashioned cottages. The flight of steps is almost invariably steep and crooked, which may add to the picturesqueness, but detracts from convenience.

Building Materials.—Originally the cottage in many parts of England was constructed of clay for walls and thatch for roof. Cottages of this type, very crude to be sure, still exist and are comfortable except for vermin, which find a refuge in the roof. Thatch more scientifically applied is practical for modern cottages, but not much used on account of the reasonable cheapness of newer materials. At the present time many kinds of tile and some slate are the chief roof materials. For walls are used brick,

stone and concrete, also cement plaster on a background of cheap masonry. Tiles and slate are used on exterior walls as well as on roofs. The building materials employed are characterized by their extreme durability, in contrast to the flimsily constructed small houses of America.

Appearance.—English cottages, whether located in the hills or valleys, or in suburban districts, appear to fit the landscape. Usually the exposure is carefully considered, the northerly walls being made secure against cold winds by reducing window area, while the southerly walls are provided with large groups of windows. Shrubbery invariably draws the house to the ground, while hedges and walls complete the domesticity of the establishment. Perhaps the main factor in producing the harmonious aspect of the English cottage is the use of local materials, which may be rough and crude, but never cheap and garish.

SKETCH PROBLEMS

(1) Make a plan and elevation of a typical English middle class cottage at the scale of $\frac{1}{16}$ " equals 1' 0."

(2) Copy a plan of an English scullery, kitchen, hall and dining room as used in a cottage.

(3) Make a rough sketch of the entrance feature of an English cottage. The materials employed should be typical.

REFERENCES

Adams.—Modern Cottage Architecture.

Arnot.—Gothic Architecture Applied to Modern Residences.

CHAPTER XX. PRACTICE OF ARCHITECTURE

THE Profession.—Architecture was perhaps the first profession. Originally all great building operations were carried on by the rulers who employed architects, sculptors and painters. They obtained funds by conquest and pilfering and secured laborers by making slaves of their captives. Means for carrying on gigantic projects were practically limitless during certain periods. Thus came about the pyramids, temples of Greece and Rome, and many other architectural monuments. In the Middle Ages the monks were the architects, and not only designed but superintended the construction of the great cathedrals of Europe. However, as architects, they laid out only the general scheme of the building, leaving all the detailing of parts to skilled artisans, each of whom did his particular part practically as he saw fit. The individuality and skill of the workman is readily observed in such details as the stone caps of columns, each of which in a building may be different from all others.

Both monarchs and monks throughout Europe engaged the services of professional architects and artists for their work at an early date. Later, architectural design and construction were turned over to specialists in almost every case, the one in authority merely suggesting the scheme. At the time of the classic revival of architecture in Europe, not only professional architects but also skilled workmen

DOMESTIC ARCHITECTURE

were imported from Italy to carry on all operations from the design of the building to the erection and completion of it. From this time, architecture became a profession in the strict sense of the word, and has since been practiced in all civilized countries. Public work has usually been done by architects held in close relationship with, and in high esteem by, the government. Many architects have been misunderstood and discredited at the time of their activity, as have the majority of artists, poets and writers. The greatness of the man shows in the durability of his work. A case of peculiar interest to Americans is that of the French architect L'Enfant, who was retained by the Government of the United States to design the Capital city. To him is due the credit of the beautiful design of the city of Washington, D. C., but owing to political conditions, which are not always just, this man was displaced and the great work entrusted to others, who eventually finished it exactly according to the original design of L'Enfant. The French architect himself did not recover from the effects of his unreasonable discharge, and for many years haunted the public offices of the Capitol in a disconsolate manner, and finally died in very straitened circumstances. Only at a comparatively recent date have the good offices of this great man been recognized.

Up to the present time architecture as a profession in the United States has not been on as firm a basis as other professions, but of recent years the organization of the American Institute

of Architects has tended to produce a satisfactory condition, which effect is not yet complete. In a number of states of the Union, architects are required to pass an examination given by a State Board of Examining Architects, and upon a satisfactory showing in the examination are granted licenses to practice architecture. Among these states are Illinois, California, New Jersey and New York. Here, then, the profession is on the soundest basis. The idea in licensing architects is to protect individuals and the public from unscrupulous and incompetent men who are liable not only to design and have erected buildings which are ugly and grotesque, but also buildings that are positively unsafe and unsanitary.

There are a great many architectural magazines devoted to the profession. These magazines for the most part illustrate and describe principally architecture of the present day. Some deal only with the larger types of buildings, some with domestic architecture, and some with both. Among the important magazines dealing with architecture proper are the "American Architect," "Architectural Review," "The Architect," "Western Architect," "Architect and Builder," "The Architectural Record," "Pacific Architect" and "The Brick Builder." Among the magazines dealing more especially with house and garden design are: "House Beautiful," "American Homes and Gardens" and "House and Garden."

Owner, Architect and Contractor.—A certain established relation exists between the "owner"

DOMESTIC ARCHITECTURE

and the "architect" and between the "owner" and the "contractor" who is granted the commission of erecting the building. The above terms are used in documents relating to the practice of architecture. In the first place an owner has a building in mind which he proposes to erect and use in a certain manner, and in most cases he has set aside a certain amount of money to be used for this purpose. Often the owner has made a rough draft or sketch of the building which he proposes to erect. Soon he finds that he is not skilled in making drawings that are sufficiently plain and concise to be used by a builder; moreover, he is not sure of the cost of the building which he has in mind. Therefore it is the logical and sensible thing to do to present his ideas and his sketch to a practicing architect who then becomes his professional advisor in regard to all things pertaining to the proposed building. It is necessary that the owner have confidence in his architect. From this time the architect works in conjunction with the owner and produces a set of preliminary drawings which show all parts of the building in sketch form. Thereby the owner may comprehend the points of utility and beauty of his scheme, and the architect may comprehend the true intent of the owner. By this procedure the owner is assured of receiving ultimate satisfaction in his building. For this part of the architect's work the fee may be one per cent of the estimated cost of the proposed building. When these preliminary drawings are accepted by the owner, it is an indication that the architect is

authorized to proceed with the work and make accurate scale drawings of the building, which include plans of the floors, elevations of all façades of the building, inside elevations of important rooms, and scale details showing the construction of the building in general and also details of cabinetwork and finish. These drawings, in turn, are approved by the owner, whereupon the architect writes a specification which covers the quality of materials and labor which are necessary for the erection and completion of the building indicated by the drawings. For this phase of the work the architect may receive two and one-half per cent of the estimated cost of the proposed building.

The next step is to have made a number of blue print copies of the drawings and a number of typewritten sets of specifications. Copies of these are sent out to reliable contractors each of whom is invited to submit a bid stating for what sum of money he will construct the building. The owner and architect compare the bids and the job of erecting the structure is usually granted to the contractor who agrees to do the work for the least sum of money. By receiving competitive bids the owner may save a considerable sum. Often the work is contracted for in parts, the heating, plumbing, and lighting each being let to a firm whose business it is to do but one of these things. The following form of agreement between the owner and the contractor is in vogue:*

* By permission of the American Institute of Architects.

DOMESTIC ARCHITECTURE

THE STANDARD FORM OF AGREEMENT BETWEEN CONTRACTOR AND OWNER

ISSUED BY THE AMERICAN INSTITUTE OF ARCHITECTS FOR USE WHEN A
STIPULATED SUM FORMS THE BASIS OF PAYMENT

The Standard Documents have received the approval of the National Association of Builders' Exchanges, the National Association of Master Plumbers, the National Association of Sheet Metal Contractors of the United States, the National Electrical Contractors' Association of the United States, the National Association of Marble Dealers, the Building Granite Quarries Association, the Building Trades Employers Association of the City of New York, and the Heating and Piping Contractors National Association.

THIRD EDITION, COPYRIGHT 1915-1918 BY THE AMERICAN INSTITUTE OF ARCHITECTS, THE
OCTAGON, WASHINGTON, D. C. THIS FORM IS TO BE USED ONLY WITH THE
STANDARD GENERAL CONDITIONS OF THE CONTRACT

THIS AGREEMENT, made the.....
day of.....in the year nineteen hundred and.....
by and between.....
hereinafter called the Contractor, and.....

.....hereinafter called the Owner,
WITNESSETH that the Contractor and the Owner for the considerations
hereinafter named agree as follows:

ARTICLE I. The Contractor agrees to provide all the materials and to
perform all the work shown on the Drawings and described in the Spec-
ifications entitled.....
(Here insert the caption descriptive of the work as used in the Proposal, General Condi-
tions, Specifications, and upon the Drawings.)

.....
prepared by.....
acting as, and in these Contract Documents entitled the Architect, and
to do everything required by the General Conditions of the Contract,
the Specifications and the Drawings.

ARTICLE II. The Contractor agrees that the work under this contract
shall be substantially completed.....
(Here insert the date or dates of completion, and stipulations as to liquidated damages,
if any.)

ARTICLE III. The Owner agrees to pay the Contractor in current
funds for the performance of the contract

.....(\$.....) subject
to additions and deductions as provided in the general conditions of the
contract and to make payments on account thereof as provided therein,
as follows: On or about the.....day of each month.....

PRACTICE OF ARCHITECTURE

..... per cent of the value, proportionate to the amount of the contract, of labor and materials incorporated in the work.
..... up to the first day of that month as estimated by the Architect, less the aggregate of previous payments. On substantial completion of the entire work, a sum sufficient to increase the total payments to per cent of the contract price, and
..... days thereafter, provided the work be fully completed and the contract fully performed, the balance due under the contract.
.....
.....

ARTICLE IV. The Contractor and the Owner agree that the General conditions of the contract, the specifications and the drawings, together with this agreement, form the contract, and that they are as fully a part of the contract, as if hereto attached or herein repeated; and that the following is an exact enumeration of the Specifications and Drawings:
.....
.....
.....
.....

The Contractor and the Owner for themselves, their successors, executors, administrators and assigns, hereby agree to the full performance of the covenants herein contained.

IN WITNESS WHEREOF, they have executed this agreement, the day and year first above written.

THE GENERAL CONDITIONS OF THE CONTRACT

STANDARD FORM OF THE AMERICAN INSTITUTE OF ARCHITECTS

The Standard Documents have received the approval of the National Association of Builders' Exchanges, the National Association of Master Plumbers, the National Association of Sheet Metal Contractors of the United States, the National Electrical Contractors' Association of the United States, the National Association of Marble Dealers, the Building Granite Quarries Association, the Building Trades Employers' Association of the City of New York, and the Heating and Piping Contractors National Association.

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THE OCTAGON, WASHINGTON, D. C.

INDEX TO THE ARTICLES OF THE GENERAL CONDITIONS

- | | |
|---------------------------------------|---------------------------------------|
| 1. Definitions. | 14. Correction Before Final Payment. |
| 2. Documents. | 15. Deductions for Uncorrected Work. |
| 3. Details and Instructions. | 16. Correction After Final Payment. |
| 4. Copies Furnished. | 17. Protection of Work and Property. |
| 5. Shop Drawings. | 18. Emergencies. |
| 6. Drawings on the Work. | 19. Contractor's Liability Insurance. |
| 7. Ownership of Drawings. | 20. Owner's Liability Insurance. |
| 8. Samples. | 21. Fire Insurance. |
| 9. The Architect's Status. | 22. Guaranty Bonds. |
| 10. The Architect's Decisions. | 23. Cash Allowances. |
| 11. Foremen, Supervision. | 24. Changes in the Work. |
| 12. Materials, Appliances, Employees. | 25. Claims for Extras. |
| 13. Inspection of Work. | 26. Applications for Payments |

DOMESTIC ARCHITECTURE

- | | |
|--|--|
| 27. Certificates and Payments. | 38. Contractor's Right to Stop Work or Terminate Contract. |
| 28. Payments Withheld. | 39. Damages. |
| 29. Liens. | 40. Mutual Responsibility of Contractors |
| 30. Permits and Regulations. | 41. Separate Contracts. |
| 31. Royalties and Patents. | 42. Assignment. |
| 32. Use of Premises. | 43. Subcontractors. |
| 33. Cleaning up. | 44. Relations of Contractor and Subcontractor. |
| 34. Cutting, Patching and Digging. | 45. Arbitration. |
| 35. Delays. | |
| 36. Owner's Right to Do Work. | |
| 37. Owner's Right to Terminate Contract. | |

ARTICLE I. PRINCIPLES AND DEFINITIONS.—

- (a) The Contract Documents consist of the Agreement, the General Conditions of the Contract, the Drawings and Specifications, including all modifications thereof incorporated in the documents before their execution. These form the Contract.
- (b) The Owner, the Contractor and the Architect are those named as such in the Agreement. They are treated throughout the Contract Documents as if each were of the singular number and masculine gender.
- (c) The term Subcontractor, as employed herein, includes only those having a direct contract with the Contractor and it includes one who furnishes material worked to a special design according to the plans or specifications of this work, but does not include one who merely furnishes material not so worked.
- (d) Written notice shall be deemed to have been duly served if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered mail to the last business address known to him who gives the notice.
- (e) The term "work" of the Contractor or Subcontractor includes labor or materials or both.
- (f) All time limits stated in the Contract Documents are of the essence of the contract.
- (g) The law of the place of building shall govern the construction of this contract.

ART. II. EXECUTION, CORRELATION AND INTENT OF DOCUMENTS.—

The Contract Documents shall be signed in duplicate by the Owner and Contractor. In case of failure to sign the General Conditions, Drawings or Specifications the Architect shall identify them.

The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all. The intention of the documents is to include all labor and materials reasonably necessary for the proper execution of the work. It is not intended, however, that materials or work nor covered by or properly inferable from any heading, branch, class or trade of the specifications shall be supplied unless distinctly so noted on the drawings. Materials or work described in words which so applied have a well known technical or trade meaning shall be held to refer to such recognized standards.

ART. III. DETAIL DRAWINGS AND INSTRUCTIONS.—The Architect shall furnish, with reasonable promptness, additional instructions, by means of drawings or otherwise, necessary for the proper execution of the work. All such drawings and instructions shall be consistent with the

PRACTICE OF ARCHITECTURE

Contract Documents, true developments thereof, and reasonably inferable therefrom. The work shall be executed in conformity therewith and the Contractor shall do no work without proper drawings and instructions. In giving such additional instructions, the Architect shall have authority to make minor changes in the work, not involving extra cost, and not inconsistent with the purposes of the building.

The Contractor and the Architect, if either so requests, shall jointly prepare a schedule, subject to change from time to time in accordance with the progress of the work, fixing the dates at which the various detail drawings will be required, and the Architect shall furnish them in accordance with that schedule. Under like conditions, a schedule shall be prepared, fixing the dates for the submission of shop drawings, for the beginning of manufacture and installation of materials and for the completion of the various parts of the work.

ART. IV. COPIES FURNISHED.—Unless otherwise provided in the Contract Documents the Architect will furnish to the Contractor, free of charge, all copies of drawings and specifications reasonably necessary for the execution of the work.

ART. V. SHOP DRAWINGS.—The Contractor shall submit, with such promptness as to cause no delay in his own work or in that of any other contractor, two copies of all shop or setting drawings and schedules required for the work of the various trades and the Architect shall pass upon them with reasonable promptness. The Contractor shall make any corrections required by the Architect, file with him two corrected copies and furnish such other copies as may be needed. The Architect's approval of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless he has in writing called the Architect's attention to such deviations at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules.

ART. VI. DRAWINGS AND SPECIFICATIONS ON THE WORK.—The Contractor shall keep one copy of all drawings and specifications on the work, in good order, available to the Architect and to his representatives.

ART. VII. OWNERSHIP OF DRAWINGS AND MODELS.—All drawings, specifications and copies thereof furnished by the Architect are his property. They are not to be used on other work and, with the exception of the signed contract set, are to be returned to him on request, at the completion of the work. All models are the property of the Owner.

ART. VIII. SAMPLES.—The Contractor shall furnish for approval all samples as directed. The work shall be in accordance with approved samples.

ART. IX. THE ARCHITECT'S STATUS.—The Architect shall have general supervision and direction of the work. He is the agent of the Owner only to the extent provided in the Contract Documents and when in special instances he is authorized by the Owner so to act, and in such instances he shall, upon request, show the Contractor written authority. He has authority to stop the work whenever such stoppage may be necessary to insure the proper execution of the Contract.

As the Architect is, in the first instance, the interpreter of the conditions of the Contract and the judge of its performance, he shall side

DOMESTIC ARCHITECTURE

neither with the Owner nor with the Contractor, but shall use his powers under the contract to enforce its faithful performance by both.

In case of the termination of the employment of the Architect, the Owner shall appoint a capable and reputable Architect, whose status under the contract shall be that of the former Architect.

ART. X. THE ARCHITECT'S DECISIONS.—The Architect shall, within a reasonable time, make decisions on all claims of the Owner or Contractor and on all other matters relating to the execution and progress of the work or the interpretation of the Contract Documents.

The Architect's decisions, in matters relating to artistic effect, shall be final, if within the terms of the Contract Documents.

Except as above or as otherwise expressly provided in these General Conditions or in the specifications, all the Architect's decisions are subject to arbitration.

ART. XI. FOREMAN, SUPERVISION.—The Contractor shall keep on his work, during its progress, a competent foreman and any necessary assistants, all satisfactory to the Architect. The foreman shall not be changed except with the consent of the Architect, unless the foreman proves to be unsatisfactory to the Contractor and ceases to be in his employ. The foreman shall represent the Contractor in his absence and all directions given to him shall be as binding as if given to the Contractor. Important directions shall be confirmed in writing to the Contractor. Other directions shall be so confirmed on written request in each case.

The Contractor shall give efficient supervision to the work, using his best skill and attention. He shall carefully study and compare all drawings, specifications and other instructions and shall at once report to the Architect any error, inconsistency or omission which he may discover.

ART. XII. MATERIALS, APPLIANCES, EMPLOYEES.—Unless otherwise stipulated, the Contractor shall provide and pay for all materials, labor, water, tools, equipment, light and power necessary for the execution of the work.

Unless otherwise specified, all materials shall be new and both workmanship and materials shall be of good quality. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

The Contractor shall not employ on the work any unfit person or anyone not skilled in the work assigned to him.

ART. XIII. INSPECTION OF WORK.—The Owner, the Architect and their representatives shall at all times have access to the work wherever it is in preparation or progress and the Contractor shall provide proper facilities for such access and for inspection.

If the specifications, the Architect's instructions, laws, ordinances or any public authority require any work to be specially tested or approved, the Contractor shall give the Architect timely notice of its readiness for inspection, and if the inspection is by another authority than the Architect, of the date fixed for such inspection. Inspections by the Architect shall be promptly made. If any such work should be covered up without approval or consent of the Architect, it must, if required by the Architect, be uncovered for examination at the contractor's expense.

Re-examination of questioned work may be ordered by the Architect. If such work be found in accordance with the contract, the Owner shall

PRACTICE OF ARCHITECTURE

pay the cost of re-examination and replacement. If such work be found not in accordance with the contract, through the fault of the Contractor, the Contractor shall pay such cost, unless he shall show that the defect in the work was caused by another contractor, and in that event the Owner shall pay such cost.

ART. XIV. CORRECTION OF WORK BEFORE FINAL PAYMENT.—The Contractor shall promptly remove from the premises all materials condemned by the Architect as failing to conform to the Contract, whether incorporated in the work or not, and the Contractor shall promptly replace and re-execute his own work in accordance with the Contract and without expense to the Owner and shall bear the expense of making good all work of other contractors destroyed or damaged by such removal or replacement.

If the Contractor does not remove such condemned work and materials within a reasonable time, fixed by written notice, the Owner may remove them and may store the material at the expense of the Contractor. If the Contractor does not pay the expense of such removal within five days thereafter, the Owner may, upon ten days' written notice, sell such materials at auction or at private sale and shall account for the net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor.

ART. XV. DEDUCTIONS FOR UNCORRECTED WORK.—If the Architect and Owner deem it inexpedient to correct work injured or done not in accordance with the Contract, the difference in value together with a fair allowance for damage shall be deducted.

ART. XVI. CORRECTION OF WORK AFTER FINAL PAYMENT.—Neither the final certificate nor payment nor any provision in the Contract Documents shall relieve the Contractor of responsibility for faulty materials or workmanship and he shall remedy any defects due thereto and pay for any damage to other work resulting therefrom, which shall appear within a period of two years from the time of installation. The Owner shall give notice of observed defects with reasonable promptness. All questions arising under this Article shall be decided under Articles X and XLV.

ART. XVII. PROTECTION OF WORK AND PROPERTY.—The Contractor shall continuously maintain adequate protection of all his work from damage and shall protect the Owner's property from injury arising in connection with this Contract. He shall make good any such damage or injury, except such as may be directly due to errors in the Contract Documents. He shall adequately protect adjacent property as provided by law and the Contract Documents.

ART. XVIII. EMERGENCIES.—In an emergency affecting the safety of life or of the structure or of adjoining property, not considered by the Contractor as within the provisions of Article XVII, then the Contractor, without special instruction or authorization from the Architect or Owner, is hereby permitted to act, at his discretion, to prevent such threatened loss or injury and he shall so act, without appeal, if so instructed or authorized. Any compensation claimed to be due to him therefor shall be determined under Articles X and XLV regardless of the limitations in Article XXV and in the second paragraph of Article XXIV.

DOMESTIC ARCHITECTURE

ART. XIX. CONTRACTOR'S LIABILITY INSURANCE.—The Contractor shall maintain such insurance as will protect him from claims under workmen's compensation acts and from any other claims for damages for personal injury, including death, which may arise from operations under this contract, whether such operations be by himself or by any subcontractor or anyone directly or indirectly employed by either of them. Certificates of such insurance shall be filed with the Owner, if he so require, and shall be subject to his approval for adequacy of protection.

ART. XX. OWNER'S LIABILITY INSURANCE.—The Owner shall maintain such insurance as will protect him from his contingent liability for damages for personal injury, including death, which may arise from operations under this contract.

ART. XXI. FIRE INSURANCE.—The Owner shall effect and maintain fire insurance upon the entire structure on which the work of this contract is to be done and upon all materials, in or adjacent thereto and intended for use thereon, to at least eighty per cent of the insurable value thereof. The loss, if any, is to be made adjustable with and payable to the Owner as Trustee for whom it may concern.

All policies shall be open to inspection by the Contractor. If the Owner fails to show them on request or if he fails to effect or maintain insurance as above, the Contractor may insure his own interest and charge the cost thereof to the Owner. If the Contractor is damaged by failure of the Owner to maintain such insurance, he may recover under Art. XXIX.

If required in writing by any party in interest, the Owner as Trustee shall, upon the occurrence of loss, give bond for the proper performance of his duties. He shall deposit any money received from insurance in an account separate from all his other funds and he shall distribute it in accordance with such agreement as the parties in interest may reach, or under an award of arbitrators appointed, one by the Owner, another by joint action of the other parties in interest, all other procedure being in accordance with Art. XLV. If after loss no special agreement is made, replacement of injured work shall be ordered under Art. XXIV.

The Trustee shall have power to adjust and settle any loss with the insurers unless one of the contractors interested shall object in writing within three working days of the occurrence of loss and thereupon arbitrators shall be chosen as above. The Trustee shall in that case make settlement with the insurers in accordance with the directions of such arbitrators, who shall also, if distribution by arbitration is required, direct such distribution.

ART. XXII. GUARANTY BONDS.—The Owner shall have the right to require the Contractor to furnish bond covering the faithful performance of the contract and the payment of all obligations arising thereunder, in such form as the Owner may prescribe and with such sureties as he may approve. If such bond is required by instructions given previous to the receipt of bids, the premium shall be paid by the Contractor; if subsequent thereto, it shall be paid by the Owner.

ART. XXIII. CASH ALLOWANCES.—The Contractor shall include in the contract sum all allowances named in the Contract Documents and shall cause the work so covered to be done by such contractors and for

PRACTICE OF ARCHITECTURE

such sums as the Architect may direct, the contract sum being adjusted in conformity therewith. The Contractor declares that the contract sum includes such sums for expenses and profit on account of cash allowances as he deems proper. No demand for expenses or profit other than those included in the contract sum shall be allowed. The Contractor shall not be required to employ for any such work persons against whom he has a reasonable objection.

ART. XXIV. CHANGES IN THE WORK.—The Owner, without invalidating the contract, may make changes by altering, adding to or deducting from the work, the contract sum being adjusted accordingly. All such work shall be executed under the conditions of the original contract except that any claim for extension of time caused thereby shall be adjusted at the time of ordering such change.

Except as provided in Articles III, IX and XVIII, no change shall be made unless in pursuance of a written order from the Owner signed or countersigned by the Architect, or a written order from the Architect stating that the Owner has authorized the change, and no claim for an addition to the contract sum shall be valid unless so ordered.

The value of any such change shall be determined in one or more of the following ways:

- (a) By estimate and acceptance in a lump sum.
- (b) By unit prices named in the contract or subsequently agreed upon.
- (c) By cost and percentage or by cost and a fixed fee.
- (d) If none of the above methods is agreed upon, the Contractor, provided he receive an order as above, shall proceed with the work, no appeal to arbitration being allowed from such order to proceed.

In cases (c) and (d), the Contractor shall keep and present in such form as the Architect may direct, a correct account of the net cost of labor and materials, together with vouchers. In any case, the Architect shall certify to the amount, including a reasonable profit, due to the Contractor. Pending final determination of value, payments on account of changes shall be made on the Architect's certificate.

ART. XXV. CLAIMS FOR EXTRAS.—If the Contractor claims that any instructions, by drawings or otherwise, involve extra cost under this contract, he shall give the Architect written notice thereof before proceeding to execute the work and, in any event, within two weeks of receiving such instructions, and the procedure shall then be as provided in Art. XXIV. No such claim shall be valid unless so made.

ART. XXVI. APPLICATIONS FOR PAYMENTS.—The Contractor shall submit to the Architect an application for each payment and, if required, receipts or other vouchers showing his payments for materials and labor, including payments to subcontractors as required by Article XLIV.

If payments are made on valuation of work done, such application shall be submitted at least ten days before each payment falls due, and if required, the Contractor shall, before the first application, submit to the Architect a schedule of values of the various parts of the work, including quantities, aggregating the total sum of the contract, divided so as to facilitate payments to subcontractors in accordance with Article XLIV (e), made out in such form and, if required, supported by such evidence as to its correctness, as the Architect may direct. This schedule,

DOMESTIC ARCHITECTURE

when approved by the Architect, shall be used as a basis for certificates of payment, unless it be found to be in error. In applying for payments, the Contractor shall submit a statement based upon this schedule and, if required, itemized in such form and supported by such evidence as the Architect may direct, showing his right to the payment claimed.

ART. XXVII. CERTIFICATES AND PAYMENTS.—If the Contractor has made application as above, the Architect shall, not later than the date when each payment falls due, issue to the Contractor a certificate for such amount as he decides to be properly due.

No certificate issued nor payment made to the Contractor, nor partial or entire use or occupancy of the work by the Owner shall be an acceptance of any work or materials not in accordance with this contract. The making and acceptance of the final payment shall constitute a waiver of all claims by the Owner, otherwise than under Articles XVI and XXIX of these conditions or under requirement of the specifications, and of all claims by the Contractor, except those previously made and still unsettled.

Should the Owner fail to pay the sum named in any certificate of the Architect or in any award by arbitration, upon demand when due, the Contractor shall receive, in addition to the sum named in the certificate, interest thereon at the legal rate in force at the place of building.

ART. XXVIII. PAYMENTS WITHHELD.—The Architect may withhold or, on account of subsequently discovered evidence, nullify the whole or a part of any certificate for payment to such extent as may be necessary to protect the Owner from loss on account of:

- (a) Defective work not remedied.
- (b) Claims filed or reasonable evidence indicating probable filing of claims.
- (c) Failure of the Contractor to make payments properly to subcontractors or for material or labor.
- (d) A reasonable doubt that the contract can be completed for the balance then unpaid.
- (e) Damage to another contractor under Article XL.

When all the above grounds are removed certificates shall at once be issued for amounts withheld because of them.

ART. XXIX. LIENS.—Neither the final payment nor any part of the retained percentage shall become due until the Contractor, if required, shall deliver to the Owner a complete release of all liens arising out of this contract, or receipts in full in lieu thereof and, if required in either case, an affidavit that so far as he has knowledge or information the releases and receipts include all the labor and material for which a lien could be filed; but the Contractor may, if any subcontractor refuses to furnish a release or receipt in full, furnish a bond satisfactory to the Owner, to indemnify him against any claim by lien or otherwise. If any lien or claim remain unsatisfied after all payments are made, the Contractor shall refund to the Owner all moneys that the latter may be compelled to pay in discharging such lien or claim, including all costs and a reasonable attorney's fee.

ART. XXX. PERMITS AND REGULATIONS.—The Contractor shall obtain and pay for all permits and licenses, but not permanent easements, and shall give all notices, pay all fees and comply with all laws, ordinances,

PRACTICE OF ARCHITECTURE

rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the drawings and specifications are at variance therewith, he shall promptly notify the Architect in writing, and any necessary changes shall be adjusted under Article XXIV. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Architect, he shall bear all costs arising therefrom.

ART. XXXI. ROYALTIES AND PATENTS.—The Contractor shall pay all royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and shall save the Owner harmless from loss on account thereof, except that the Owner shall be responsible for all such loss when the product of a particular manufacturer or manufacturers is specified, but if the Contractor has information that the article specified is an infringement of a patent he shall be responsible for such loss unless he promptly gives such information to the Architect or Owner.

ART. XXXII. USE OF PREMISES.—The Contractor shall confine his apparatus, the storage of materials and the operations of his workmen to limits indicated by law, ordinances, permits or directions of the Architect and shall not unreasonably encumber the premises with his materials.

The Contractor shall not load or permit any part of the structure to be loaded with a weight that will endanger its safety.

The Contractor shall enforce the Architect's instructions regarding signs, advertisements, fires and smoking.

ART. XXXIII. CLEANING UP.—The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish caused by his employees or work and at the completion of the work he shall remove all his rubbish from and about the building and all his tools, scaffolding and surplus materials and shall leave his work "broom clean" or its equivalent, unless more exactly specified. In case of dispute the Owner may remove the rubbish and charge the cost to the several contractors as the Architect shall determine to be just.

ART. XXXIV. CUTTING, PATCHING AND DIGGING.—The Contractor shall do all cutting, fitting or patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by work of other contractors shown upon, or reasonably implied by, the Drawings and Specifications for the completed structure and he shall make good after them, as the Architect may direct.

Any cost caused by defective or ill-timed work shall be borne by the party responsible therefor.

The Contractor shall not endanger any work by cutting, digging or otherwise and shall not cut or alter the work of any other contractor save with the consent of the Architect.

ART. XXXV. DELAYS.—If the Contractor be delayed in the completion of the work by any act or neglect of the Owner or the Architect, or of any employee of either, or by any other contractor employed by the Owner, or by changes ordered in the work, or by strikes, lockouts, fire, unusual delay by common carriers, unavoidable casualties or any causes beyond the Contractor's control, or by delay authorized by the Architect pending arbitration, or by any cause which the Architect shall decide to justify the delay, then the time of completion shall be extended for such reasonable time as the Architect may decide.

DOMESTIC ARCHITECTURE

No such extension shall be made for delay occurring more than seven days before claim therefor is made in writing to the Architect. In the case of a continuing cause of delay, only one claim is necessary.

If no schedule is made under Art. III, no claim for delay shall be allowed on account of failure to furnish drawings until two weeks after demand for such drawings and not then unless such claim be reasonable.

This article does not exclude the recovery of damages for delay by either party under Article XXXIX or other provisions in the contract documents.

ART. XXXVI. OWNER'S RIGHT TO DO WORK.—If the Contractor should neglect to prosecute the work properly or fail to perform any provision of this contract, the Owner, after three days' written notice to the Contractor, may, without prejudice to any other remedy he may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor; provided, however, that the Architect shall approve both such action and the amount charged to the Contractor.

ART. XXXVII. OWNER'S RIGHT TO TERMINATE CONTRACT.—If the Contractor should be adjudged a bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency, or if he should, except in cases recited in Article XXXV, persistently or repeatedly refuse or fail to supply enough properly skilled workmen or proper materials, or if he should fail to make prompt payment to subcontractors or for material or labor, or persistently disregard laws, ordinances or the instructions of the Architect, or otherwise be guilty of a substantial violation of any provision of the contract, then the Owner, upon the certificate of the Architect that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy and after giving the Contractor seven days' written notice, terminate the employment of the Contractor and take possession of the premises and of all materials, tools and appliances thereon and finish the work by whatever method he may deem expedient. In such case the Contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the contract price shall exceed the expense of finishing the work, including compensation to the Architect for his additional services, such excess shall be paid to the Contractor. If such expense shall exceed such unpaid balance, the Contractor shall pay the difference to the Owner. The expense incurred by the Owner as herein provided, and the damage incurred through the Contractor's default, shall be certified by the Architect.

ART. XXXVIII. CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE CONTRACT.—If the work should be stopped under an order of any court, or other public authority, for a period of three months, through no act or fault of the Contractor or of any one employed by him, or if the Owner should fail to pay to the Contractor, within seven days of its maturity and presentation, any sum certified by the Architect or awarded by arbitrators, then the Contractor may, upon three days' written notice to the Owner and the Architect, stop work or terminate this contract and recover from the Owner payment for all work executed and any loss sustained upon any plant or material and reasonable profit and damages.

PRACTICE OF ARCHITECTURE

ART. XXXIX. DAMAGES.—If either party to this contract should suffer damage in any manner because of any wrongful act or neglect of the other party or of any one employed by him, then he shall be reimbursed by the other party for such damage.

Claims under this clause shall be made in writing to the party liable within a reasonable time of the first observance of such damage and not later than the time of final payment, except in case of claims under Article XVI, and shall be adjusted by agreement or arbitration.

ART. XL. MUTUAL RESPONSIBILITY OF CONTRACTORS.—Should the Contractor cause damage to any other contractor on the work, the Contractor agrees, upon due notice, to settle with such contractor by agreement or arbitration, if he will so settle. If such other contractor sues the Owner on account of any damage alleged to have been so sustained, the Owner shall notify the Contractor, who shall defend such proceedings at the Owner's expense and, if any judgment against the Owner arise therefrom, the Contractor shall pay or satisfy it and pay all costs incurred by the Owner.

ART. XLI. SEPARATE CONTRACTS.—The Owner reserves the right to let other contracts in connection with this work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work and shall properly connect and coördinate his work with theirs.

If any part of the Contractor's work depends for proper execution or results upon the work of any other contractor, the Contractor shall inspect and promptly report to the Architect any defects in such work that render it unsuitable for such proper execution and results. His failure so to inspect and report shall constitute an acceptance of the other contractor's work as fit and proper for the reception of his work, except as to defects which may develop in the other contractor's work after the execution of his work.

To insure the proper execution of his subsequent work the Contractor shall measure work already in place and shall at once report to the Architect any discrepancy between the executed work and the drawings.

ART. XLII. ASSIGNMENT.—Neither party to the Contract shall assign the contract without the written consent of the other, nor shall the Contractor assign any moneys due or to become due to him hereunder, without the previous written consent of the Owner.

ART. XLIII. SUBCONTRACTS.—The Contractor shall, as soon as practicable after the signature of the contract, notify the Architect in writing of the names of subcontractors proposed for the principal parts of the work and for such others as the Architect may direct and shall not employ any that the Architect may within a reasonable time object to as incompetent or unfit.

If the Contractor has submitted before signing the contract a list of subcontractors and the change of any name on such list is required or permitted after signature of agreement, the contract price shall be increased or diminished by the difference between the two bids.

The Architect shall, on request, furnish to any subcontractor, wherever practicable, evidence of the amounts certified to on his account.

The Contractor agrees that he is as fully responsible to the Owner for the acts and omissions of his subcontractors and of persons either directly

DOMESTIC ARCHITECTURE

or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

Nothing contained in the contract documents shall create any contractual relation between any subcontractor and the Owner.

ART. XLIV. RELATIONS OF CONTRACTOR AND SUBCONTRACTOR.—The Contractor agrees to bind every subcontractor and every subcontractor agrees to be bound, by the terms of the General Conditions, Drawings and Specifications, as far as applicable to his work, including the following provisions of this Article, unless specifically noted to the contrary in a subcontract approved in writing as adequate by the Owner or Architect. This does not apply to minor subcontracts.

The Subcontractor agrees—

- (a) To be bound to the Contractor by the terms of the General Conditions, Drawings and Specifications and to assume toward him all the obligations and responsibilities that he, by those documents, assumes toward the Owner.
- (b) To submit to the Contractor applications for payment in such reasonable time as to enable the Contractor to apply for payment under Article XXVI of the General Conditions.
- (c) To make all claims for extras, for extensions of time and for damages for delays or otherwise, to the Contractor in the manner provided in the General Conditions for like claims by the Contractor upon the Owner, except that the time for making claims for extra cost as under Article XXV of the General Conditions is one week.

The Contractor agrees—

- (d) To be bound to the Subcontractor by all the obligations that the Owner assumes to the Contractor under the General Conditions, Drawings and Specifications and by all the provisions thereof affording remedies and redress to the Contractor from the Owner.
- (e) To pay the Subcontractor, upon the issuance of certificates, if issued under the schedule of values described in Article XXVI of the General Conditions, the amount allowed to the Contractor on account of the Subcontractor's work to the extent of the Subcontractor's interest therein.
- (f) To pay the Subcontractor, upon the issuance of certificates, if issued otherwise than as in (e), so that at all times his total payments shall be as large in proportion to the value of the work done by him as the total amount certified to the Contractor is to the value of the work done by him.
- (g) To pay the Subcontractor to such extent as may be provided by the Contract Documents or the subcontract, if either of these provides for earlier or larger payments than the above.
- (h) To pay the Subcontractor on demand for his work or materials as far as executed and fixed in place, less the retained percentage, at the time the certificate should issue, even though the Architect fails to issue it for any cause not the fault of the Subcontractor.
- (j) To pay the Subcontractor a just share of any fire insurance money received by him, the Contractor, under Article XXV of the General Conditions.

PRACTICE OF ARCHITECTURE

- (k) To make no demand for liquidated damages or penalty for delay in any sum in excess of such amount as may be specifically named in the subcontract.
- (l) That no claim for services rendered or materials furnished by the Contractor to the Subcontractor shall be valid unless written notice thereof is given by the Contractor to the Subcontractor during the first ten days of the calendar month following that in which the claim originated.
- (m) To give the Subcontractor an opportunity to be present and to submit evidence in any arbitration involving his rights.
- (n) To name as arbitrator under Article XLV of the General Conditions the person nominated by the Subcontractor, if the sole cause of dispute is the work, materials, rights or responsibilities of the Subcontractor; or, if of the Subcontractor and any other subcontractor jointly, to name as such arbitrator the person upon whom they agree.

The Contractor and the Subcontractor agree that—

- (o) In the matter of arbitration, their rights and obligations and all procedure shall be analogous to those set forth in Article XLV of the General Conditions.

Nothing in this Article shall create any obligation on the part of the Owner to pay to or to see to the payment of any sums to any Subcontractor.

ART. XLV. ARBITRATION.—Subject to the provisions of Article X, all questions in dispute under this contract shall be submitted to arbitration at the choice of either party to the dispute. The Contractor agrees to push the work vigorously during arbitration proceedings.

The demand for arbitration shall be filed in writing with the Architect, in the case of an appeal from his decision, within ten days of its receipt and in any other case within a reasonable time after cause thereof and in no case later than the time of final payment, except as to questions arising under Article XVI. If the Architect fails to make a decision within a reasonable time, an appeal to arbitration may be taken as if his decision had been rendered against the party appealing.

No one shall be nominated or act as an arbitrator who is in any way financially interested in this contract or in the business affairs of either the Owner, Contractor or Architect.

The general procedure shall conform to the laws of the State in which the work is to be erected. Unless otherwise provided by such laws, the parties may agree upon one arbitrator; otherwise there shall be three, one named, in writing, by each party to this contract, to the other party and to the Architect, and the third chosen by these two arbitrators, or if they fail to select a third within ten days, then he shall be chosen by the presiding officer of the Bar Association nearest to the location of the work. Should the party demanding arbitration fail to name an arbitrator within ten days of his demand, his right to arbitration shall lapse. Should the other party fail to choose an arbitrator within said ten days, then such presiding officer shall appoint such arbitrator. Should either party refuse or neglect to supply the arbitrators with any papers or information demanded *ex parte*, the arbitrators are empowered by both parties to proceed *ex parte*.

DOMESTIC ARCHITECTURE

The arbitrators shall act with promptness. If there be one arbitrator his decision shall be binding; if three the decision of any two shall be binding. Such decision shall be a condition precedent to any right of legal action, and wherever permitted by law it may be filed in Court to carry it into effect.

The arbitrators, if they deem that the case demands it, are authorized to award to the party whose contention is sustained such sums as they shall deem proper for the time, expense and trouble incident to the appeal and, if the appeal was taken without reasonable cause, damages for delay. The arbitrators shall fix their own compensation, unless otherwise provided by agreement, and shall assess the costs and charges of the arbitration upon either or both parties.

The award of the arbitrators must be in writing and, if in writing, it shall not be open to objection on account of the form of the proceedings or the award, unless otherwise provided by the laws of the State in which the work is to be erected.

In the event of such laws providing on any matter covered by this article otherwise than as hereinbefore specified, the method of procedure throughout and the legal effect of the award shall be wholly in accordance with the said State laws, it being intended hereby to lay down a principle of action to be followed, leaving its local application to be adapted to the legal requirements of the place in which the work is to be erected.

During the process of the construction of the building the architect inspects all parts as they are put in place, and makes certain that the labor and materials used are as indicated by the drawings and specifications. He supplies full size detail drawings to the contractor when necessary. For this work of inspection and superintendence the architect receives from the owner a fee of two and one-half per cent of the cost of the building as shown by the agreement between the owner and the contractor. Usually the architect has received only about ninety per cent of his previous fees, and from this time on his percentage is based on the actual cost of the building rather than the proposed cost. The total fee of the architect amounts to six per cent of the entire cost. Architects' fees in different parts of the country and for different kinds of buildings may vary from three per cent

PRACTICE OF ARCHITECTURE
to twenty per cent of the cost of the completed
structure.

The following form of agreement between the
owner and the architect is used extensively: *

THE STANDARD FORM OF AGREEMENT BETWEEN OWNER AND ARCHITECT

ISSUED BY THE AMERICAN INSTITUTE OF ARCHITECTS FOR USE WHEN A
PERCENTAGE OF THE COST OF THE WORK FORMS THE BASIS OF PAYMENT.

SECOND EDITION—COPYRIGHT 1917 BY THE AMERICAN INSTITUTE OF ARCHITECTS,
WASHINGTON, D. C.

THIS AGREEMENT made the.....
day of.....in the year nineteen hundred and.....
by and between.....
hereinafter called the Owner, and.....
.....hereinafter called the Architect,....
WITNESSETH, that whereas the Owner intends to erect.....

NOW, THEREFORE, the Owner and the Architect, for the considerations
hereinafter named, agree as follows:

The Architect agrees to perform, for the above-named work, profes-
sional services as stated in Article I of the "Conditions of Agreement
between Owner and Architect," hereinafter set forth.

The Owner agrees to pay the Architect at the rate of
per cent, hereinafter called the basic rate, computed and payable as
stated in the said "Conditions," and to make any other payments and
reimbursements arising out of the said "Conditions."

The parties hereto further agree to the following:

CONDITIONS OF AGREEMENT BETWEEN OWNER AND ARCHITECT

ARTICLE I. THE ARCHITECT'S SERVICES.—The Architect's professional
services consist of the necessary conferences, the preparation of prelimi-
nary studies, working drawings, specifications, large scale and full size
detail drawings; the drafting of forms of proposals and contracts; the issu-
ance of certificates of payment; the keeping of accounts, the general
administration of the business and supervision of the work.

ART. II. THE ARCHITECT'S FEE.—The fee payable by the Owner to
the Architect for the performance of the above services is the percentage
hereinbefore defined as the basic rate, computed upon the cost of the

* By permission of the American Institute of Architects.

DOMESTIC ARCHITECTURE

work in respect of which such services have been performed, subject, however, to any modifications growing out of these Conditions of Agreement.

ART. III. REIMBURSEMENTS.—The Owner is to reimburse the Architect the costs of transportation and living incurred by him and his assistants while travelling in discharge of duties connected with the work, and the costs of the services of heating, ventilating, mechanical, and electrical engineers.

ART. IV. SEPARATE CONTRACTS.—The basic rate as hereinbefore defined is to be used when all of the work is let under one contract. Should the Owner determine to have certain portions of the work executed under separate contracts, as the Architect's burden of service, expense, and responsibility is thereby increased, the rate in connection with such portions of the work shall be four per cent greater than the basic rate. Should the Owner determine to have substantially the entire work executed under separate contracts, then such higher rate shall apply to the entire work. In any event, however, the basic rate shall, without increase, apply to contracts for any portions of the work on which the Owner reimburses the Engineer's fees to the Architect, and to the cost of articles not designed by the Architect but purchased under his direction.

ART. V. EXTRA SERVICES AND SPECIAL CASES.—If after a definite scheme has been approved, the Owner makes a decision which, for its proper execution, involves extra services and expense for changes in or additions to the drawings, specifications or other documents; or if a contract be let by cost of labor and material plus a percentage or fixed sum; or if the Architect is put to labor or expense by delays caused by the Owner or a contractor, or by the delinquency or insolvency of either, or as a result of damage by fire he shall be equitably paid for such extra service and expense.

Should the execution of any work designed or specified by the Architect, or any part of such work be abandoned or suspended, the Architect is to be paid in accordance with or in proportion to the terms of Article VI for the service rendered on account of it up to the time of such abandonment or suspension.

ART. VI. PAYMENTS.—Whether the work be executed or whether its execution be suspended or abandoned in part or whole, payments to the Architect on his fee are, subject to the provisions of Article V, to be made as follows:

Upon completion of the preliminary studies, a sum equal to 20% of the basic rate computed upon a reasonable estimated cost.

Upon completion of specifications and general working drawings (exclusive of details) a sum sufficient to increase payments on the fee to 60% of the rate or rates of commission arising from this agreement, computed upon a reasonable cost estimated on such completed specifications and drawings, or if bids have been received, then computed upon the lowest bona fide bid or bids.

From time to time during the execution of work and in proportion to the amount of service rendered by the Architect, payments shall be made until the aggregate of all payments made on account of the fee under this Article, but not including any covered by the provisions of Article V,

PRACTICE OF ARCHITECTURE

shall be a sum equal to the rate or rates of commission arising from this agreement, computed upon the final cost of the work.

Payments to the Architect, other than those on his fee, fall due from time to time as his work is done or as costs are incurred.

No deduction shall be made from the Architect's fee on account of penalty, liquidated damages, or other sums withheld from payments to contractors.

ART. VII. THE OWNER'S DECISIONS.—The Owner shall give thorough consideration to all sketches, drawings, specifications, proposals, contracts, and other documents laid before him by the Architect and, whenever prompt action is necessary, he shall inform the Architect of his decisions in such reasonable time as not to delay the work of the Architect nor to prevent him from giving drawings or instructions to contractors in due season.

ART. VIII. SURVEY, BORINGS, AND TESTS.—The Owner shall furnish the Architect with a complete and accurate survey of the building site, giving the grades and lines of streets, pavements, and adjoining properties; the rights, restrictions, easements, boundaries, and contours of the building site, and full information as to sewer, water, gas, and electrical service. The Owner is to pay for borings or test pits and for chemical, mechanical, or other tests when required.

ART. IX. SUPERVISION OF THE WORK.—The Architect will endeavor to guard the Owner against defects and deficiencies in the work of contractors, but he does not guarantee the performance of their contracts. The supervision of an architect is to be distinguished from the continuous personal superintendence to be obtained by the employment of a clerk-of-the-works.

When authorized by the Owner, a clerk-of-the-works acceptable to both Owner and Architect shall be engaged by the Architect at a salary satisfactory to the Owner and paid by the Owner, upon presentation of the Architect's monthly certificates.

ART. X. PRELIMINARY ESTIMATES.—When requested to do so, the Architect will make or procure preliminary estimates on the cost of the work and he will endeavor to keep the actual cost of the work as low as may be consistent with the purpose of the building and with proper workmanship and material, but no such estimate can be regarded as other than an approximation.

ART. XI. DEFINITION OF THE COST OF THE WORK.—The words "the cost of the work" as used in Article II and VI hereof are ordinarily to be interpreted as meaning the total of the contract sums incurred for the execution of the work, not including Architect's and Engineer's fees, or the salary of the clerk-of-the-works, but in certain rare cases, e. g., when labor or material is furnished by the Owner below its market cost or when old materials are re-used, the cost of the work is to be interpreted as the cost of all materials and labor necessary to complete the work, as such cost would have been if all materials had been new and if all labor had been fully paid at market prices current when the work was ordered, plus contractor's profits and expenses.

ART. XII. OWNERSHIP OF DOCUMENTS.—Drawings and specifications as instruments of service are the property of the Architect whether the work for which they are made be executed or not.

DOMESTIC ARCHITECTURE

ART. XIII. SUCCESSORS AND ASSIGNMENT.—The Owner and the Architect, each binds himself, his successors, executors, administrators, and assigns to the other party to this agreement, and to the successors, executors, administrators, and assigns of such other party in respect of all the covenants of this Agreement.

The Architect shall have the right to join with him in the performance of this agreement, any architect or architects with whom he may in good faith enter into partnership relations. In case of the death or disability of one or more partners, the rights and duties of the Architect, if a firm, shall devolve upon the remaining partner or partners or upon such firm as may be established by him or them, and he, they or it shall be recognized as the "successor" of the Architect, and so on until the service covered by the agreement has been performed. The Owner shall have the same rights, but in his case no limitation as to the vocation of those admitted to partnership is imposed.

Except as above, neither the Owner nor the Architect shall assign, sublet or transfer his interest in this agreement without the written consent of the other.

ART. XIV. ARBITRATION.—All questions in dispute under this Agreement shall be submitted to arbitration at the choice of either party. The general procedure shall conform to the laws of the State in which the work is to be erected.

The parties may agree upon one arbitrator; otherwise there shall be three, one named in writing by each party and the third chosen by these two arbitrators, or if they fail to select a third within ten days he shall be chosen by the presiding officer of the Bar Association nearest to the location of the work. Should the party demanding arbitration fail to name an arbitrator within ten days of his demand, his right to arbitration shall lapse. Should the other party fail to choose an arbitrator within the said ten days, then such presiding officer shall appoint such arbitrator. Should either party refuse or neglect to supply the arbitrators with any papers or information demanded in writing, the arbitrators are empowered by both parties to proceed *ex parte*.

If there be one arbitrator his decision shall be binding; if three, the decision of any two shall be binding. Such decision shall be a condition precedent to any right of legal action, and wherever permitted by law it may be filed in court to carry it into effect. The arbitrators shall fix their own compensation, unless otherwise provided by agreement, and shall assess the costs and charges of the arbitration upon either or both parties. The award of the arbitrators must be in writing and, if in writing, shall not be open to objection on account of the form of the proceedings or the award.

The Owner and the Architect hereby agree to the full performance of the covenants contained herein,

IN WITNESS WHEREOF they have executed this agreement, the day and year first above written.

In Presence of

.....	}	as to.....
.....		
.....	}	as to.....
.....		

SKETCH PROBLEMS

(1) Assume a simple rectangular house with a gable roof and show by diagram all of the drawings of it as would be made by an architect in the preparation of working drawings. All diagrams may be on one sheet of paper.

(2) Make a preliminary sketch plan of a small house showing an arrangement of rooms that would be generally practical and economical. The house may be your own idea of what a small suburban house in your favorite locality should be. Draw at an approximate scale of $\frac{1}{16}"$ equals 1' 0".

(3) Make a list of heads and sub-heads from which the specifications for a frame dwelling could be written.

REFERENCES

Clark.—Architect, Owner and Builder Before the Law.

Wait.—Engineering and Architectural Jurisprudence.

Kidder.—Architects' and Builders' Pocket-Book.

The Standard Documents of the American Institute of Architects.

CHAPTER XXI. COST OF DWELLINGS

METHODS of Estimating.—The cost of a building depends, of course, upon its size and quality, and also upon the locality. It may be said that buildings of masonry cost approximately one-third more than buildings of frame, while fire-proof buildings, that is, buildings constructed entirely of materials that are not inflammable, cost three times as much as frame buildings. Such a general statement is approximate only, since a masonry building, for instance, may be made to cost almost any amount.

Methods of determining the cost of a future building have been worked out. The safest method is to have a practical builder or firm of contractors estimate all things that are to go into the building, which estimation is arrived at by using building plans and specifications made by an architect. However, in a great many instances, it is necessary to find approximately what a building will cost before complete plans and specifications are made. Perhaps the best method of determining the cost under such conditions is to find the cubic contents of the proposed building, assume a quality for all materials and judge that each cubic foot of contents will cost a certain amount. These amounts vary from five cents to seventy-five cents. The contents of the building may be found by multiplying the ground area by the height of the building from the basement floor to the middle of the attic space. Irregular parts of a building and porches may be figured separately to find the

cubic contents. The cost per cubic foot of contents for the most simple frame building or barn would be from five to ten cents; for a small cheap residence, fifteen cents; for an inexpensive modern suburban frame house, twenty cents; for a good suburban house of frame, thirty cents; for a residence of masonry, forty cents; for plain fire-retarding buildings, fifty cents; for fire-proof buildings, eighty cents; and so on to elaborately designed buildings, including a great many fixtures which would cost perhaps one dollar per cubic foot of contents. This cost includes the building complete with heating, plumbing and lighting appliances. In this method of estimation, it is necessary to use good judgment in assuming a certain cost for each cubic foot of contents. The method may be used accurately only by one skilled or familiar with the method.

Another simple way to find out about what a building will cost before the plans are made is by estimating the ground area. For frame dwellings having from one thousand to two thousand square feet of ground area and containing perhaps eight rooms, the cost per square foot will be between \$6.00 and \$10.00. It is necessary to take into consideration the design of the dwelling in assuming a certain cost for each square foot of ground area. A one-story house will cost less than a two-story house of the same ground area and an elaborate house will of course cost more than a plain house of the same shape. Perhaps the maximum cost would be \$10.00 and the minimum \$4.00 per square foot

DOMESTIC ARCHITECTURE

of area. Area means ground and not floor area.

Still another method of determining cost is by assuming that each room of the dwelling will cost a certain amount. This amount would be from \$500 per room up to \$1,000 per room. For the average inexpensive house it would be safe to assume that each room will cost about \$800. Thus a house of ten rooms including bathroom and store room might cost \$8,000.00.

The cost of building the same residence in different parts of the country would vary considerably. Also the terms "cheap," "average," and "good" do not mean the same to all. Perhaps the approximate costs here given pertain most nearly to the great central part of the United States while the costs in the East are higher and in the South and Northwest are lower. In California the range of costs is very wide.

Architects use one or more of these schemes of estimating with practically every proposed building in order to save themselves the tremendous expense of making a set of plans, which, when estimated by building firms would be found to cost far more and occasionally far less than the stipulated amount for expenditure. The person about to build a home may use one of these systems advantageously, if well advised about building design and construction. Perhaps the best method is the one whereby the total cost of a dwelling is estimated by the cubic contents of the building.

Example.—An example of estimating the cost

of a house is here given. The house is about forty feet square and from the basement floor to the middle of the attic space is about twenty-four feet high. The contents are 38,400 cubic feet. At seventeen cents per cubic foot, the cost of the building would be \$6,528. Since this house is about forty feet square, the ground area is 1,600 square feet. At \$4.00 per square foot, the cost of the house would be \$6,400. The house contains ten rooms, which at \$600 per room, would make the house cost \$6,000. This example is for a house of very cheap construction, being a story and a half frame dwelling with concrete basement, finished with fir and two coat plaster work on the inside, and rustic siding and shingles on the outside. By actual estimation from working drawings, it is found that the total construction would cost \$5,200; the plumbing, \$550; hot air heating, \$300; electric lighting, \$300; making a total of \$6,350.

Controlling Factors.—Certain factors control to quite a degree the cost of a building. It is usually cheaper to build in the fall of the year rather than in the spring, since not so much building construction is being carried on and consequently there is not the same demand for labor, which makes it much cheaper. The location for the building is of importance in that an isolated site requires a long haul of the building materials, which adds to their cost. A convenient location reduces the cartage bill. The use of local materials rather than imported materials cheapens a building in that the price of local building materials is usually less. It is advisable

DOMESTIC ARCHITECTURE

that local materials be used for several reasons: first, they generally look better; second, they are cheaper; third, the products of home industries should be employed. By receiving competitive bids made from architects' drawings a saving is accomplished.

Economical Points of Buildings.—The simple two-story square house is the cheapest, but unfortunately is not the best or the easiest of arrangement. A very good compromise under the circumstances is to make the house rectangular in shape by which the building is still economical, also easily arranged, and pleasing in form. Simple structures without projecting parts cost less than buildings of irregular plan. Each bay window, porch and balcony adds considerably to the cost. A two-story house of the same total floor area as a one-story house will cost much less. Here, again, a suitable compromise is possible by building a one and a half story dwelling. Whenever possible, the flues for a house should be enclosed within the same stack or chimney, thereby reducing the cost. In general, the unpretentious compact house costs less than the rambling structure. Rather than to sacrifice design to strict economy, it is much better to plan reasonably and thereby have a house that is not only economical but artistic.

Cost of Masonry.—The cheap dwelling is not always the most economical in that up-keep will soon raise the initial cost to an unreasonably high figure. It is best to build well and thereby avoid the expense of repairs and painting.

Masonry construction requires very little attention in the way of up-keep, since it is in itself permanent and durable. Concrete foundations cost about \$10.00 per cubic yard. Concrete floors cost about twenty-four cents per square foot; stone facing or ashlar costs from \$1.00 to \$2.00 per square foot; bricks cost from \$14.00 to \$50.00 per thousand and will cost accordingly, when laid up with mortar forming walls. Ordinarily brick walls made of common brick with facing of good brick will cost about seventy cents per cubic foot. Hollow tile walls cost about the same as common brick walls. Tile facing costs about \$1.00 per square foot of area. The facing may be employed either on walls or floors.

Cost of Framing and Exterior Wood Finish.—

Lumber for framing a wood building costs perhaps \$40.00 per thousand board feet, a board foot being a block of wood twelve inches long, twelve inches wide and one inch thick. Weather boarding on the outside of a building, put in place and painted three coats, costs about \$15.00 per one hundred square feet. Stained shingles cost approximately the same. Finished lumber, used for window casings, barge boards, rafter ends, and other exterior details, costs about \$60.00 per thousand board feet. Mouldings cost about two cents per linear foot for one inch width.

Cost of Interior Finish.—Interior materials are for the most part wood and plaster. Finishing woods from mahogany to yellow pine have a wide difference in cost, the former being worth

DOMESTIC ARCHITECTURE

about \$300 per thousand board feet, the latter \$75.00 per thousand board feet. Finished quarter-sawed oak floors cost about forty cents per square foot. White maple floors cost thirty cents per square foot, and hard pine or fir floors, edge grained, cost about twenty cents per square foot.

The cost of plaster work varies with its quality. Two coat sand finish work on wood lath costs per square yard about fifty cents. Three coat hard finish plaster on wood lath costs per square yard about seventy cents. Plaster mouldings are put up by the linear foot, the cost depending upon the elaborateness of the design.

Fixtures and Special Details.—For estimating the cost of plumbing it is generally assumed that each fixture throughout the building costs a certain amount, which includes all labor and materials. These amounts vary from \$80.00 to \$150.00 per fixture, depending upon the size of the house and the quality of the fixtures used. For the average house containing six plumbing fixtures, the cost per fixture would probably be about \$80.00, the total bill amounting to \$480.00. Electric lighting costs from \$2.50 to \$4.00 for each outlet, including all wiring complete in conduits. Thus for a house having thirty outlets for general use, it would cost perhaps \$100.00. The fixtures themselves would be an additional cost, the amount depending upon the kind selected. Gas costs about \$2.00 per outlet; hot air furnaces cost between \$30.00 and \$50.00 per register, for small houses; and

COST OF DWELLINGS

about \$30.00 or more per register for large houses. For steam heating, the cost is from \$80.00 to \$90.00 per radiator. Hot water heating costs from \$90.00 to \$100.00 per radiator.

Chimneys cost perhaps \$50.00, while a fireplace may cost \$70.00 for the masonry and \$40.00 for the mantel. Thus a fireplace complete costs approximately \$110.00. Some fireplaces would cost less and some considerably more. A common door costs \$5.00; a door frame about \$3.00, and the finish or casing on both sides, \$4.00 more. Therefore a complete door opening between two rooms costs about \$12.00, which with hardware costing \$4.00 more, makes a total of \$16.00. Windows complete cost about \$20.00 an opening. Storm windows cost about \$4.00 extra, and blinds \$5.00.

Addendum.—As a further example of the cost of a dwelling, a two-story frame Colonial house of good quality erected and completed for \$10,000, would probably have cost by parts about as follows:

Excavation	~~\$~~ 200.00
Masonry work	1,400.00
Wood framing	1,200.00
Exterior finish	1,000.00
Lathing and plastering	660.00
Interior finish complete	1,600.00
Plumbing	800.00
Steam heating	640.00
Finish hardware	600.00
Painting complete	500.00
Electric lighting	400.00
Architect's fee	500.00
Contractor's profit	500.00
	\$10,000.00

DOMESTIC ARCHITECTURE

This house would have a ground area of 1,500 square feet, which at \$7.00 per square foot would cause the house to cost \$10,500.00. The contents would be 420,000 cubic feet, which at twenty-five cents per cubic foot would cause the house to cost \$10,500.00.

Thus, the cost of any dwelling not yet erected may be quite accurately estimated if good judgment is employed.

SKETCH PROBLEMS

(1) Estimate and show by diagram and figures the cost of a small house with which you are familiar, using as a basis the cubic contents of the building.

(2) Estimate the cost of the same house by finding out the ground area.

(3) Estimate the cost of the house by allowing a certain amount of money for the cost of each room.

(4) Verify the costs found by the actual cost of the building under consideration.

REFERENCES

Bevier.—The House. (Article by Frank Chouteau Brown.)

Kidder.—Architects' and Builders' Pocket-Book.

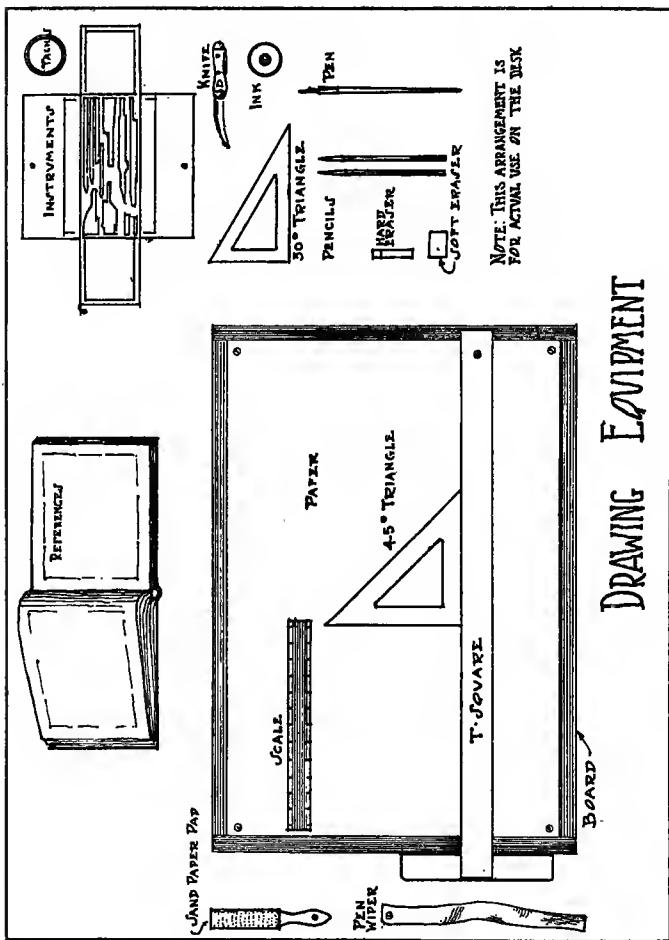


Plate 50 A

PART TWO—A PRACTICAL GUIDE FOR HOUSE DESIGN

DRAFTING ROOM MANUAL

Instruments.—The following equipment is necessary for elementary architectural drafting:

Drawing board 24" x 20".

T-square 24".

Architect's scale.

45° Triangle—8" sides.

Soft eraser.

HB pencils.

Thumb tacks.

Yellow pencil.

Light brown drawing paper (heavy weight)
22" x 16".

Sandpaper pad.

The following additional equipment is necessary for advanced drafting:

Set of drawing instruments.

Drawing board 32" x 22" or Imperial size.

India ink.

Roll of tracing paper 18" long (used for preliminary sketching).

BB pencils (used for sketching).

Hot pressed Whatman paper, Imperial size.

Paste, sponge and bowl for mounting paper.

The T-square fits on the left edge of the drawing board and is used in making horizontal lines. The triangle slides on the T-Square and is used in making vertical lines and diagonal lines at 45°. The scale is divided into small parts indicating feet and inches which are applied to the paper on the board to represent real feet and

DOMESTIC ARCHITECTURE

inches. Thus drawings are made to a scale of $1/2''$ equals $1' 0''$, etc. The paper is held to the drawing board by the use of thumb tacks and should not be removed until the drawing is complete.

Kinds of Drawings.—The chief drawings used to represent buildings or parts of buildings are called plans, elevations, sections and details. A plan is a view looking down and shows floor arrangement. An elevation is a view looking toward and shows wall treatment. A section is a view obtained by passing an imaginary plane through any given part, thereby separating it and representing the part exposed by a drawing. The plane cutting through a part at which a section drawing is made may be at any angle but should be defined. A detail is a drawing of a particular part at large scale. For sketches still another kind of drawing is employed, called perspective. A perspective view is a view showing how an object actually looks, as is a photograph. However, a photograph is a mechanical likeness of a real object while a perspective is a picture made by hand but not sketched from a real object. It is made according to certain perspective principles from plans and elevations. For the method, treatises on perspective may be consulted.

Conventional Indications.—Plans are made according to conventional indications generally accepted. Thereby drawings may be made by one draftsman and conveniently read by any other because the symbols used are known to him. The symbols are realistic for the most part

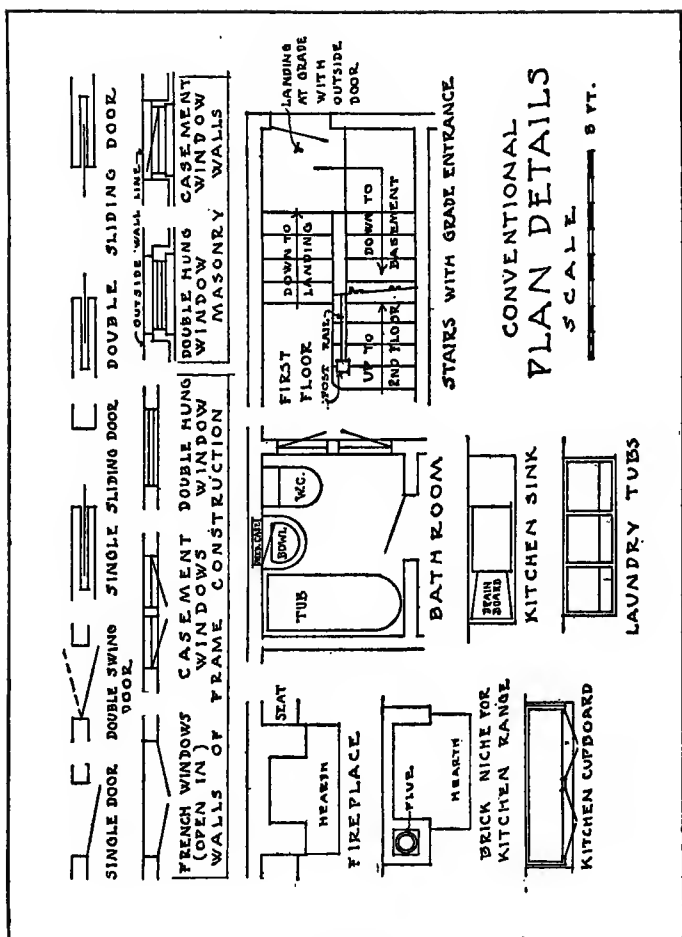


Plate 50
INDICATIONS USED ON PLANS

DOMESTIC ARCHITECTURE

so that a layman can tell what they mean to a great extent. Thus a door is indicated by a line which looks like a door ajar. It is necessary to learn these conventional indications which may be accomplished by copying Plate 50. Elevations are made as literally as possible, that is, each part is actually drawn. In large scale drawings many more details or small parts may be shown than in small scale drawings.

Architectural Terms.—Many terms are so familiar as to need no mention such as door, window, roof, etc. Other terms are so unfamiliar as need never to be mentioned such as finial, intaglia, ichnography, etc. However, there are a number of terms used by architects and builders which should be known to a student of domestic architecture. A list of these comprises the glossary of architectural terms on page 359.

Dimensions.

SUGGESTED DIMENSIONS OF ROOMS

	Minimum	Maximum
Kitchens.....	8' x 8'	19' x 19'
Pass pantries.....	5' x 5'	7' x 12'
Dining rooms.....	11' x 14'	17' x 25'
Living rooms.....	13' x 17'	21' x 40'
Libraries, music rooms, museums... Alcoves		15' x 35'
Reception rooms..	10' x 10'	13' x 20'
Bedrooms.....	7' x 11'	17' x 25'
Bathrooms.....	5' x 6'	9' x 15'
Laundry.....	9' x 9'	17' x 17'
Nursery.....	8' x 8'	13' x 17'
Billiard rooms....	13' x 17'	15' x 20'
Halls—with double stairway.....	6' wide	15' wide
Passages—with single stairway.....	3' wide	5' wide
Front porches.....	10' wide	20' wide
Back porches.....	4' wide	14' wide

USUAL DIMENSIONS OF BUILT-IN PARTS

1. Fireplaces—3' 0" to 4' 6", width of opening.
2. Kitchen shelves—12" wide to 4" wide.
3. Bookcase shelves—10" wide to 6" wide.
4. Working counters—34" high, 22" wide.
5. Tables—same height as counters when used in kitchen.
6. Window seats—16" to 24" high, 20" wide.
7. Doors and windows—7' high, usually.
8. Width of windows—2' to 4'.
9. Casement, or French windows—2' each, in pairs.
10. Large window for special purpose,—landscape window of plate glass—6' to 8' wide.
11. Width of inside doors—2' 6". Closet doors are sometimes narrower. Living and dining room doors are sometimes wider, 3' to 4'.
12. Width of outside doors—3' 0" to 3' 6".
13. Width of cupboard doors—16". Sliding cupboard doors are often wider.
14. Steps consist of treads and risers. In plan the treads (T) show and in elevation the risers (R) show.

	Riser	Tread
Outside steps	4"	14"—easy
T + R = 18"	5"	13"—good
	6"	12"—average
	7"	11"—steep
Inside steps	5"	12"—easy
T + R = 17"	6"	11"—good
	7"	10"—average
	8"	9"—steep

DOMESTIC ARCHITECTURE

APPROXIMATE DIMENSIONS OF FURNITURE

Dining chairs—18" high, 19" deep, 20" wide.

Davenport—8' long—30" wide.

Dining tables—2' 6" high, 3' 6" to 4' 0" wide;
also 4', 5', 6' diameter.

Reading tables—2' 6" high.

Beds—single, 3' to 4' wide, 6' 8" long.

Three-quarter, 4' to 4' 4" wide.

Double, 5' wide.

Chiffoniers—3' wide, 1' 6" deep, 4' 6" high.

Dressers—3' 6" wide, 1' 6" deep, 2' 6" high.

Pianos—Upright—5' long, 2' 4" deep.

Baby grands—6' long, 4' 6" deep.

Parlor grands—6' 6" long, 5' deep.

Concert grands—9' long, 5' deep.

Billiard tables—4' to 5' wide, 8' to 10' long.

Range—2' 6" x 4' 0".

DIMENSIONS OF PLUMBING FIXTURES

Bath tubs—30" wide, 4' to 6' long.

Lavatories—16" x 20" or 14" to 16" diameter.

Water-closets—width 16", depth, 24".

Foot baths—22" x 20".

Seat baths—32" x 27".

Shower baths—4' 0" x 4' 0", floor space.

Kitchen sinks—16" x 24" to 20" x 36".

Slop sinks—16" x 16".

Pantry sinks—14" x 20".

Laundry tubs—16" x 24" each.

Range boilers—12" to 20" diameter.

Equipment for Rooms.—Note: All parts and articles are not essential.

1. Kitchen.

- a. Range.
 - b. Flue. Locate chimney first and plan to have the range directly by the chimney.
 - c. Gas or electric range.
 - d. Hot water tank near to range.
 - e. Wood lift, if used, or wood box.
 - f. Sink and drain boards.—Drain boards should be as long as possible and on both sides of the sink. If only one, it should be on the left.
 - g. Cupboards, bearing in mind what goes in each.
 - h. Stool and chair.
 - i. Service wagon.
 - j. Cooler.
 - k. Ice-box.
 - l. Kitchen closet, for brooms, etc.
 - m. Working counter and bins, dresser or cabinet.
 - n. Outside door.
 - o. Cellar door, close to kitchen.
 - p. Windows on two sides.
 - q. Register, if heated by hot air.
Radiator, if heated by steam or hot water.
- Note: One of these is needed if gas or electric range is used.
- r. Central light from ceiling and wall brackets.
 - s. Power outlets (at least 3) for electric machines.
 - t. Ironing board and cabinet.

DOMESTIC ARCHITECTURE

2. Dining room.

- a. Buffet or sideboard.
- b. China cupboard.
- c. Service table at pass pantry door or kitchen door.
- d. Dining room suite.
- e. As many windows as possible,—a conservatory.
- f. Lighting and heating apparatus.

3. Pantries.

- I. Pass pantry.
- II. Storage pantry.
 - a. Counters.
 - b. Cupboards.
 - c. Sink.
 - d. Lighting apparatus.

4. Den.

- a. Fireplace.
- b. Bookcases.
- c. Davenport.
- d. Heating and lighting apparatus.

5. Hall.

- a. Windows and doors.
- b. Stairway.
- c. Vestibule preceding hall.
- d. Cloak closet with shelves, hooks and lavatory.
- e. Seat or stand.
- f. Heating and lighting apparatus.

6. Living room.

- a. Fireplace.
- b. Piano, space on inside wall.
- c. Window seats.

- d. Other furniture.
 - e. Heating and lighting apparatus.
- 7. Reception room.
 - a. Formal equipment.
 - b. Heating and lighting apparatus.
- 8. Libraries.
 - a. Bookcases.
 - b. Table.
 - c. Heating and lighting apparatus.
- 9. Bedrooms.
 - a. Bed.
 - b. Dressing table.
 - c. Chiffonier, or dresser.
 - d. Night stand.
 - e. Wardrobe or closet.
 - f. Heating and lighting apparatus.
- 10. Dressing room.
 - a. Hanging space.
 - b. Wardrobe.
 - c. Dressing table.
 - d. Heating and lighting apparatus.
- 11. Bathroom.
 - a. Plumbing fixtures.
 - b. Heating and lighting apparatus.
 - c. Medicine case.
 - d. Towel case.
 - e. Linen closet in proximity.

PROBLEMS IN DESIGN

Problem I: *Conventional Plan Details.*—Copy Plate 50 at scale of $\frac{1}{2}"$ equals 1' 0". Use sheet of paper 22" x 16" and allow a border 1" wide on all sides. Use HB pencil for all lines and lettering. Sign name in lower right hand corner.

Problem II: *A Kitchen Annex to House of Colonial Type.*—Assume a symmetrical Colonial house 48' x 30', having on the first floor a parlor, a music room, a living room, a hall 10' wide through the centre and a dining room on the northeast corner. The house faces south and is a frame structure having walls six inches thick. The family to occupy the house will maintain one servant.

Design a kitchen wing on the north side of the main rectangular unit reached from both the front hall and the dining room. The wing or addition to the house is to contain a back hall, a stairway up and down, a porch, a pass pantry and a kitchen fully equipped. The addition may have a breakfast room, a closet and a dining room porch.

Drawing is to be presented as a sketch plan at scale of $\frac{1}{2}"$ equals 1' 0". All lines are to be firm pencil lines and walls are to be colored with yellow pencil. See Plates 22, 23, 24 and 25. Size of paper is to be regulation size.

Problem III: *A Formal Cottage.*—Assume a lot 100' x 100' in a small New England town. The lot has two fronts, north and east, on equally important streets and is practically level. The house is to accommodate two people.

Design a formal cottage containing a living

room, a dining room, a kitchen, two bedrooms and all accessories including halls, bathroom, closets, linen closet, chimneys and porches. Only these rooms and no others are to be provided. The house may be one and one-half stories high.

Draw plan or plans, if two, at the scale of $\frac{1}{4}$ " equals 1' 0". Locate in the rooms all equipment. Built-in fixtures are to be indicated by light solid lines and movable fixtures and furniture by dotted lines. See Plate 16.

Problem IV: *An Informal Cottage.*—Assume a small farm in the middle west which is the home of a retired professor. The building site for a new house is on a slight elevation away from the main road and is in the centre of a grove of white oaks. The family to occupy the house or cottage consists of four adult members. No hired help will be employed in the beginning but may be needed at a later time.

Design an informal cottage of eight rooms and accessories preferably all on one floor but with a stairway to the attic where may be sleeping porches and store rooms. Draw plan or plans at scale of $\frac{1}{4}$ " equals 1' 0". See Plate 21.

Problem V: *A Typical Bungalow on the Pacific Coast.*—Assume a lot 50' x 100' facing east in the centre of a block. The village is situated in a valley and contains for the most part cement plaster houses. The building is to accommodate three people at most, who live modestly on a limited income. The building is to be salable and consequently should not be extreme.

Design a bungalow conveniently and econom-

DOMESTIC ARCHITECTURE

ically arranged. The ground area may not be more than 1,200 square feet. The distance from the basement floor to the centre of the attic space may not be more than 22 feet. The cubic contents, therefore, may be only 26,400 cubic feet. At 15 cents per cubic foot the building would cost about \$4,000. The interior and exterior finish must be very simple.

Make drawings of plan at scale of $\frac{1}{4}"$ equals 1' 0" and of elevation at scale of $\frac{1}{16}"$ equals 1' 0". See Plates 17 and 19.

Problem VI: *A House for the Average Family.*—Assume a typical narrow lot 50' x 100' facing north in a good suburban district of a middle eastern small city. On this lot is to be erected a house to accommodate a family of two adults and three children and also at times one servant.

Design an economical but artistic frame structure with two main floor areas having a living room, dining room, small study, kitchen, halls, porches, bath, four bedrooms, sleeping porch and all necessary accessories. It is suggested that the main entrance be at one side rather than in the front of the building. Draw first floor and second floor plans at the scale of $\frac{1}{4}"$ equals 1' 0".

Problem VII: *A Prairie Farmhouse.*—Assume a farm of 640 acres in Illinois operated by the owner. Besides the owner and his wife there are four growing children, two hired women and two hired men comprising the household. The chosen site for the structure is a slightly elevated tract of land 400 feet square on the public

highway facing south. The tract is barren of trees.

Design a farmhouse of the old New England type providing living room, dining room, kitchen, store pantry, wash room, fuel room, milk room, office, sewing room, two bathrooms, seven bedrooms, halls and closets, and also a sitting room for hired help. Although the house is to have many rooms they are to be small to reduce cost. All treatments are to be very simple especially exterior porches, cornices, etc. The basement may be used for some rooms.

Draw first floor, second floor and basement plans at scale of $\frac{1}{4}"$ equals 1' 0". Also make a very small or thumb-nail sketch of exterior. Estimate cost of this structure allowing for expenditure to make the house ready for occupancy the sum of 9 cents per cubic foot of contents.

Problem VIII: *A Plastered House of English Type.*—Assume a large building site in a small Oregon town where the climate is moderate but very rainy. A family of five desires to erect a permanent, bright and convenient dwelling at low cost. Consequently a frame house with cement plaster finish is selected as the type. On account of the desire for brightness no wide projecting cornices are wanted and for the same reason many casement windows are to be employed.

Design a practical house of unsymmetrical proportions containing a living room, dining room, den, kitchen, pass pantry, bathroom, four bedrooms and all necessary accessories,

DOMESTIC ARCHITECTURE

Terraces are preferred to covered porches and a sleeping porch is desired in the second story. If possible, a play room in the attic is to be incorporated since this style of house would have a steep roof and consequently a roomy attic space.

Draw first and second floor plans at $\frac{1}{4}''$ scale and two elevations at $\frac{1}{16}''$ scale. Estimate cost of structure allowing only 8 cents for each cubic foot of contents. The height of this building from basement floor to middle of attic space would be about 32' 0''.

Problem IX: *A Colonial House.*—Assume a building site in a suburban district near a large city. The site is very pleasing, having a gradual slope back from the street in front and being level with the two side streets that bound it on the east and west. An alley is in the rear. The dimensions of the lot are 200' x 200'. It is the intention of the owner to erect a permanent brick dwelling upon the site to be used by a household consisting of two adults, five children and two domestics.

Design a Colonial house to cost not more than \$20,000. The building is to be especially dignified and at the same time homelike.

Draw plans of first and second floors at scale of $\frac{1}{8}''$ equals 1' 0'', and a very small sketch elevation. See Plates 12, 13 and 14, and also Plates 10, 11 and 16.

Problem X: *A Garden for an Informal House.*—Assume that the house shown on Plate 15 is to be located on a lot 200' x 200' with the street on the north side of the lot but the outlook

toward the south. The ground slopes in all directions very gradually.

Design the garden showing drives, walks, garden structures and plantings. Make a sketch plan at scale of 1" equals 20'. See Plate 47 for indications.

Problem XI: *The Main Wall of a Bungalow Living Room.*—Assume an informal cottage or bungalow living room to have a north wall 9' high and 16' long. This wall has in it one or more windows, a fireplace and other features.

Design the main wall of a bungalow living room, giving it architectural treatment and balance. Make an elevation at scale 1" equals 1' 0". Show all woodwork especially. See Plates 26, 27, 28 and 29.

Problem XII: *Kitchen Details.*—Draw elevation and section through counter and bins of fixtures indicated on north wall of kitchen shown on Plate 22. Make drawings at scale 1" equals 1' 0". See Plates 34 and 35.

Problem XIII: *Own House.*—Assume a building site and design own house of any style to cost not more than \$5,000.00. Make plans at scale of 1/4" equals 1' 0".

GLOSSARY OF ARCHITECTURAL TERMS

1. **Abacus:** The upper member of the capital of a column.
2. **Alcove:** A large recess in a room usually separated from it by an arch or beam.
3. **Apron:** A piece of wood finish below the stool of the window.
4. **Arcade:** A series of arches. See Plate 38.
5. **Arch:** The form of an opening or treatment having a curved top. See Plate 38.
6. **Architrave:** The lower part of an entablature. A door or window casing.
7. **Area:** An open space below grade in front of a basement window.
8. **Ashlar:** A facing of squared stones. See Plate 39.
9. **Astragal:** A semicircular moulding. A wood strip covering the crack between two hinged doors or windows. See Plate 36.
10. **Axis** (plural, Axes). A straight line, imaginary, through the centre.
11. **Backfill:** Material thrown into an excavation against a foundation wall. See Plate 42.
12. **Backing:** A rough surface behind a finish material.
13. **Balcony:** A projecting floor and balustrade.
14. **Baluster:** One of the spindles or columns forming a balustrade. See Plate 39.
15. **Balustrade:** A series of balusters between a base and a rail supported at intervals by pedestals or columns. See Plate 39.
16. **Band:** A flat moulding or fascia. See Plate 36.
17. **Barge Board.**—One of a pair of boards under the verge of a gable usually supported by brackets. See Plate 43.
18. **Base:** A lower part.
19. **Batten:** A small strip of wood.
20. **Batter:** An incline in a wall away from the front.
21. **Bay:** A division in architectural treatment.
22. **Bead:** A circular moulding. See Plate 36.
23. **Beam:** A horizontal support. Beams are often non-supporting or false.

DOMESTIC ARCHITECTURE

24. **Bed Mould:** A moulding fitted under a wide projecting part.
25. **Belt:** A horizontal band or set of mouldings.
26. **Bevel:** The surface obtained by cutting off a sharp corner.
27. **Bond:** A binding or pattern showing method of binding. See Plate 40.
28. **Bracket:** An ornamental projecting member supporting a cornice or a beam. See Plate 37.
29. **Bridging:** Stiffeners between joists or studs.
30. **Butt Joint:** A joint formed by placing the end of one member against another member.
31. **Buttress:** A mass of masonry projecting beyond a wall to take thrust or pressure. See Plate 38.
32. **Cap or Capital:** The upper part or member of a column, pier or pilaster.
33. **Casement:** A hinged window.
34. **Chute:** A small open shaft, as a linen chute. See Plate 12.
35. **Clerestory:** The upper part of a high story having a set of windows. See Plate 38.
36. **Colonnade:** A series of columns.
37. **Column:** A post or round pillar. See Plate 38.
38. **Conductor:** A metal pipe for conducting water from the roof or eaves.
39. **Conduit:** A pipe to carry an electric wire. Any pipe or tunnel for conducting.
40. **Coping:** A continuous capping for a wall.
41. **Corbel:** A projection in a masonry wall made by setting courses beyond the lower ones.
42. **Cornice:** The crowning member of a wall. See Plate 43.
43. **Counter Shelf:** The narrow shelf in front of a cupboard at the counter line.
44. **Cove or Coving:** A continuous concave surface. See Plate 35.
45. **Crown:** An uppermost moulding.
46. **Curb:** A very small, low wall.
47. **Curb Roof:** See Plate 38.
48. **Deck:** The flat part of a roof. See Plate 38.
49. **Dentil:** One of a series of ornamental cogs or teeth.

GLOSSARY OF ARCHITECTURAL TERMS

50. **Dormer:** A small projection from a roof containing a window. See Plate 38.
51. **Double-action Door:** A door swinging both ways. See Plate 50.
52. **Dowel:** A wood or metal pin used to hold two parts together.
53. **Downspout:** See conductor.
54. **Drip:** A groove cut on the under side of a projecting part to cause rain water to drip rather than flow back to the wall.
55. **Eaves:** That part of a roof which overhangs the wall.
56. **Engaged Column:** A part of a column attached to a wall or pier.
57. **Entasis:** The curving in the shaft of a column.
58. **Escutcheon:** A shield, ground or plate; also the hardware on a door to accommodate the knob and keyhole.
59. **Facade:** An important face of a building.
60. **Facing:** A finish material to cover.
61. **Finish:** Any material used for finishing.
62. **Flange:** A projecting rib or rim.
63. **Flashing:** Sheet metal used over joints in roofs and walls to keep out water. See Plate 43.
64. **Flue:** A compartment of a chimney to carry off smoke or foul air.
65. **Flush Surface:** A continuous surface without an angle.
66. **Flute:** A concave channel.
67. **Footings:** The wide courses of masonry at the base of a foundation wall. See Plate 42.
68. **Framing:** The rough timberwork of a structure. See Plate 42.
69. **Fresco:** A color decoration on plaster.
70. **Frieze:** An upper horizontal band of wall.
71. **Furring:** Wood strips on the inside of a masonry wall to support lath and plaster. See Plate 43.
72. **Gable:** The upper part of a wall terminating the roof. See Plate 38.
73. **Gambrel:** A roof with two pitches. See Plate 38.
74. **Gargoyle:** A grotesque figure used for a waterspout.

DOMESTIC ARCHITECTURE

- 75. **Girder:** A constructive member to support joists.
- 76. **Grade:** The ground line. See Plate 43.
- 77. **Grade Door:** A stair door at the ground line. See Plate 12.
- 78. **Grille:** A metal screen.
- 79. **Groove:** A square sunk channel to receive a tongue, as tongue and groove flooring.
- 80. **Grounds:** Small wood blocks flush with the plaster surface on which to nail finish or trim. An estate or plot of ground.
- 81. **Grout:** Very thin mortar.
- 82. **Gutter:** A channel for carrying off rain water. See Plate 43.
- 83. **Head:** The upper jamb on a door or window.
- 84. **Header:** The short face of a brick. A timber into which other timbers are butted and spiked.
- 85. **Head-room:** Space beneath a stair where any person may comfortably walk.
- 86. **Hearth:** The floor in front of a fireplace. See Plate 50.
- 87. **Hip-roof:** A roof sloping in all four directions. See Plate 38.
- 88. **Hood:** A covering over an entrance. A metal canopy above a range to conduct foul air to a vent.
- 89. **Hopper-bin:** A tilting bin shaped as a hopper.
- 90. **Inglennook:** An alcove containing usually a fireplace, seats and bookcases. See Plate 27.
- 91. **Jamb:** The side and sometimes the top of an interior opening.
- 92. **Joist:** One of the timbers to which the flooring is nailed. See Plate 42.
- 93. **Keystone:** The central stone of an arch.
- 94. **Landing:** A platform in a flight of steps. See Plate 50.
- 95. **Lath:** Strips of wood used as a background for plaster.
- 96. **Lattice:** Any work made by crossing strips of wood or metal.
- 97. **Lean-to:** A shed whose rafters lean against another building or other part of the same building. See Plate 38.

GLOSSARY OF ARCHITECTURAL TERMS

98. **Lintel:** A horizontal structural member over an opening.
99. **Loggia:** A sheltered gallery or portico. See Plate 12.
100. **Louvre:** A slat in a ventilating window. The window itself containing horizontal slats to exclude rain but admit air.
101. **Mansard roof:** See Plate 38.
102. **Mantel:** The shelf part of a fireplace.
103. **Meeting-rail:** The double rail between the upper and lower sash of a double hung window.
104. **Member:** A unit employed in design or construction.
105. **Mezzanine Floor:** A balcony floor. See Plate 38.
106. **Mitre:** A joint formed by cutting members at an angle and butting together.
107. **Modillion:** One of a series of ornamental blocks as found in the Corinthian entablature.
108. **Mortise:** A pocket cut in a wood member to receive a tenon forming a mortise and tenon joint.
109. **Mould or moulding:** See Plates 36 and 37.
110. **Mullion:** A post between windows.
111. **Muntin:** A division between lights of a window.
112. **Newel-Post:** The large post terminating a stair rail. See Plate 37.
113. **Niche:** A small recess in a wall. See Plate 50.
114. **Nosing:** A projecting round edge, commonly used on the tread of a stairs.
115. **Order:** See Plate 36.
116. **Pane:** A window light.
117. **Panel:** A framed part.
118. **Panelling:** Framed work including panels, stiles and rails.
119. **Parapet:** A low wall. See Plate 38.
120. **Parquetry:** Wood flooring of small matched pieces.
121. **Pass Cupboard:** A cupboard between and opening into two rooms.
122. **Pass Pantry:** A butler's pantry. See Plate 23.
123. **Pedestal:** A support consisting of a base, die and cap for a statue or a column. See Plate 39.
124. **Pediment:** A gable as used in classic architecture. See Plate 38.

DOMESTIC ARCHITECTURE

- 125. **Pergola:** An arbor originated by the Italians. See Plate 45.
- 126. **Pier:** A solid, square post. See Plate 39.
- 127. **Pilaster:** A part of a square column attached to a wall. See Plate 39.
- 128. **Pillar:** A post or column.
- 129. **Plate:** A structural member used as a bearing. See Plate 43.
- 130. **Plinth:** A square block at the base.
- 131. **Plumb:** Perpendicular.
- 132. **Porte Cochere:** A carriage or automobile porch.
- 133. **Portico:** A classic porch.
- 134. **Post:** A perpendicular supporting member.
- 135. **Pull:** A handle to a drawer.
- 136. **Quoins:** Squared stones or masses of brick used at the corners of masonry walls.
- 137. **Rabbet:** See Rebate.
- 138. **Rafters:** Timbers used to frame a roof.
- 139. **Rail:** A horizontal member as chair rail, hand rail, etc. Also a horizontal member in panelling.
- 140. **Ramp:** A concave or sloping hand rail or balustrade.
- 141. **Rebate:** A groove on the edge of a wood member.
- 142. **Retaining Wall:** A wall to hold back an earth embankment.
- 143. **Return:** A moulding or member that turns and terminates against a surface.
- 144. **Reveal:** The outside jamb surface of an opening.
- 145. **Ribbon:** See Plate 42.
- 146. **Ridge:** The top edge or divide of a roof.
- 147. **Riser:** The vertical member or distance in the step of a stairs.
- 148. **Rubble:** See Plate 39.
- 149. **Sash:** The frame that holds the glass of a window.
- 150. **Sheathing:** The underboarding on the rough frame.
- 151. **Shed Roof:** See Lean-to. See Plate 38.
- 152. **Shoe Mould:** The small mould against the base-board at the floor.
- 153. **Siding:** Weatherboarding or wood facing on a structure.
- 154. **Sill:** A main horizontal member at the base used as

GLOSSARY OF ARCHITECTURAL TERMS

- a bearing for the superstructure. Also a window sill.
155. **Slide Cupboard:** See Pass Cupboard.
 156. **Sleeper:** A timber imbedded in earth or concrete to receive floor joists or flooring.
 157. **Soffit:** The under surface of a projecting part.
 158. **Spindle:** One of the small balusters of a stair rail.
 159. **Splay:** An oblique jamb surface.
 160. **Spring Line:** The line from which an arch springs.
 161. **Stack:** A chimney.
 162. **Stile:** A vertical member in panelling. See Plate 46.
 163. **Stoop:** A seat before the door. A small entrance.
 164. **Stool:** An inside window sill. See Apron.
 165. **Stop:** A small strip to hold a door or window sash in place.
 166. **Stretcher:** The long face of a brick. See Header.
 167. **Studding:** The uprights used in framing.
 168. **Tenon:** See Mortise.
 169. **Terrace:** A raised level space without a roof or covering having sloping sides. See Plate 12.
 170. **Threshold:** The sill piece of a doorway.
 171. **Throat:** The opening between a fireplace and the flue proper. See Plate 30.
 172. **Tie:** A structural member to bind together.
 173. **Tongue:** See Groove.
 174. **Transom Bar:** The rail between a door and a transom.
 175. **Tread:** The horizontal member or distance in the step of a stairs.
 176. **Trellis:** A frame of latticework for supporting vines.
 177. **Trim:** The woodwork of a room.
 178. **Trimmer:** A timber at the side of a framed opening butting into a header. See Header.
 179. **Turret:** A small tower. See Plate 6.
 180. **Upright:** Any member standing on end.
 181. **Valley:** An internal angle formed by the intersection of roof planes.
 182. **Vent:** A ventilating duct or a ventilator.
 183. **Verge Board:** See Barge Board.
 184. **Vista:** A distant view down an avenue through trees.

DOMESTIC ARCHITECTURE

- 185. **Wainscoting or Wainscot:** Facing for the lower part of an interior wall.
- 186. **Water Table:** A projecting mould near the base on the outside of a building to turn the rain water outward.
- 187. **Well:** An opening in the floor for a stairway or similar feature.
- 188. **Wing:** An annex or a projecting part of a building.

INDEX

A

Abacus, 371
 Acanthus, 122
 Acetylene gas, 230, 255
 Aesthetic sense, 1, 40, 126
 Agreement between owner and architect, 339
 contractor, 324
 Air, 240, 249
 compressors, 232
 Alcoves, 88
 Alleys, 45
 American Institute of Architects, 320
 Anchoring frame construction, 183
 Angle irons, 160
 Appliances, 229
 English cottage, 313
 Approaches, 281, 299
 Aprons, 92
 Arbors, 84, 286
 Arcades, 56, 129
 Arches, 129
 stone, 138
 Architect, function of the, 321
 Architects, American Institute of, 320
 Architectural drafting, 355
 furniture, 87
 magazines, 321
 Architecture, art of, 1, 20, 277
 landscape, 277
 practice of, 319
 profession of, 319
 Architrave, 92, 120, 371
 Arc lamps, 262
 Arrangement of flowers, 223
 furniture, 218
 miscellaneous articles, 222
 pictures, 220
 rooms, 58
 Arts, allied, 126
 Asbestos, 161, 242
 Ashlar, 136
 Ash pit, 96
 Assyrian architecture, 8
 Astragal, 371
 Attic space, 85

Attic, insulation of, 161
 Automatic gas heaters, 233
 Axes, 53, 87

B

Babylonian architecture, 8
 Backfilling, 180
 Balance, 55, 91
 Baluster, 371
 Balustrades, 58, 371
 Barge board, 190, 371
 Baseboards, 91
 Basements, 85
 floors of, 180
 Bases, 120
 Bathrooms, decoration of, 216
 design of, 66
 equipment for, 363
 size of, 358
 Bath tubs, 66, 274
 size of, 360
 Batter boards, 176
 Bays, 56
 Beams, ceiling, 92, 98, 371
 Beaver board, 211
 Bed mould, 372
 Bedrooms, architectural furniture for, 99
 decoration of, 213
 design of, 64
 equipment for, 363
 size of, 358
 Beds, built-in, 99
 size of, 360
 Belt courses. (*See* Mouldings)
 Bench mark, 177
 Beveled edges, 103, 124
 Bids, competitive, 323
 Billiard rooms, 62, 85
 Billiard tables, size of, 360
 woodwork of, 99
 Bins, 112
 Blinds, cost of, 351
 Blue prints, 323
 Board foot, 349
 Boards, bread, 110
 drain, 74, 114
 work, 113
 Bog gardens, 290

INDEX

Boilers, range, 268
 size of range, 360
 steam, 245
 Bolts, 160
 Bookcases, 98
 for cook-books, 115
 Bower-Barf finish for iron, 167
 Box cornices, 188
 gutters, 188
 Braces, 185
 Brass, 167
 Bread boards, 110
 Brick joints, 142
 patterns, 142
 veneer, 174
 Brickwork, 142
 Bricks, 138, 169
 Bricks, common, 139
 enameled, 140
 face, 139
 fire, 139
 glazed, 139
 interior face, 170
 paving, 139
 Bronze, 168
 Buffets. (*See* Sideboards)
 Building materials, common, 133
 finish, 163
 Building papers, 160, 186
 Built-in furniture, 87
 English cottage, 314
 Bungalows, 36, 69, 75
 Butler's pantry, 74. (*See* Pantries,
 Pass)
 Butt joint, 372
 Buttresses, 129
 Butts, 166

C

Cabinets. (*See* Cupboards)
 ironing board, 115
 medicine, 66, 102
 special, 99
 Cabinet work, 94
 Calcimining, 208
 Candle power, 254
 Candles, 253
 Canvas, 206, 209
 Capitals, 120
 Caps, 120
 Carpentry, 174

Cases. (*See* Cabinets and Cup-
 boards)
 Casings, 92
 Cast iron. (*See* Iron)
 Castles, mediæval, 12
 Catch basins, 270
 Ceiling heights, 88
 Cellars. (*See* Basements)
 Cements, 144, 164
 Center lines. (*See* Axes)
 Cesspools, 272
 Chair rails, 91
 Chairs, 225
 size of dining, 360
 Channels, 121
 Character and mouldings, 117
 Character of colonial houses, 126
 exteriors, 54, 190
 gardens, 277
 miscellaneous styles, 128
 Charges of architects, 322
 Chiffoniers, built-in, 100
 size of, 360
 Chimneys, 181, 185
 cost of, 351
 China cupboards, 74, 102, 106
 Cinders for walks, 281
 Circuit breakers, 261
 Circulation, 58, 219, 298
 Cisterns, 269
 City lots, 44
 Classical mouldings, 117
 Clay for bricks, 139
 for bearing, 177
 Clerestory, 372
 Closets, 64
 Clothes chutes, 66
 Cloth for wall decoration, 209, 211
 Coal, 255
 Coals, 312
 Colonial architecture, 20, 127
 character of, 126
 Colonial architecture in New Eng-
 land, 34
 in the middle colonies, 28
 in the south, 31
 Colonnades, 56
 Color, 203
 of bricks, 140
 of light, 253
 Columns, 120

- Comparison of the orders of architecture, 119
 - Composite order, 123
 - Composition, 55, 218
 - of mouldings, 119
 - Compression tanks, 231
 - Concrete, 144
 - materials for, 163
 - reinforced, 145
 - Concrete blocks, 146
 - Concrete walls, 178
 - Conductors. (*See* Downspouts)
 - Conduits, 259
 - Conservatories, 70
 - Construction, house, 174
 - Consumption of air, 249
 - of water, 267
 - Contour maps, 296
 - Contractor, 321
 - Contracts. (*See* Agreements)
 - Contrast of parts, 56
 - Corinthian order, 122
 - Cornices, 54, 120
 - brick, 141
 - exterior, 188
 - interior, 92
 - Cost, 344
 - methods of estimating, 344
 - Cost of chimneys, 351
 - doors, 351
 - electric lighting, 350
 - fireplaces, 351
 - framing, 349
 - gas, 350
 - hot air heating, 350
 - hot water heating, 351
 - interior finish, 349
 - masonry, 348
 - painting, 350
 - plaster, 350
 - plumbing, 350
 - steam heating, 350
 - windows, 351
 - Cottages, Dutch Colonial, 30
 - English, 310
 - New England, 26
 - Counters, kitchen, 104, 110
 - size of, 359
 - Cranes, 236
 - Cromlechs, 2
 - Crown, 372
 - Cubic contents, 344
 - Cupboards, china, 74, 102, 106
 - construction of, 197
 - cool, 115
 - dry, 106
 - pantry, 106
 - pass, 72, 74, 103
 - service, 72, 74, 103
 - spice, 106
 - ventilated, 115, 237
 - Curb roof. (*See* Plate 38)
 - Curtains, 226
 - Cut-outs, 261
- D
- Dampness, 174
 - Damp-proofing, 180
 - Datum, 297
 - Davenport, size of, 360
 - Daylight, 251
 - Deadening quilts, 160
 - Decoration, interior, 204
 - period, 206
 - Dens, 63, 85
 - equipment of, 362
 - Dentils, 121
 - Design, garden, 295
 - house, 51
 - interior, 87
 - room, 87
 - Detail drawing, definition of, 356
 - Devices, miscellaneous, 236
 - Diaper work, 142
 - Die, 120
 - Diffusion of light, 253
 - Dimensions. (*See* Sizes)
 - Dimensions of built-in parts, 359
 - furniture, 360
 - plumbing fixtures, 360
 - rooms, 358
 - Dining and cooking apartments, 68
 - Dining rooms, architectural furniture for, 102
 - design of, 64, 68, 80
 - equipment for, 362
 - size of, 358
 - Dining tables, size of, 360
 - Documents, 321
 - Dolmens, 2
 - Domus, 11
 - Door frames, 187

INDEX

Doors, 88, 196
 cost of, 351
 cupboard, 108
 English cottage, 316
 size of, 359
 Doric order, 121
 Dormers, kinds of, 129
 Dovetail joining, 196
 Downspouts, 160, 269
 Drafting room manual, 355
 Drafts, chimney, 96
 Drainage, 269
 Drain boards, 74, 114
 Drain pipes, 269
 Drain tiles, 143, 269
 Drawers, 197
 Drawings, architectural, 356
 topographical, 296
 working, 323
 Dressers, built-in, 100
 size of, 360
 Dressing rooms, architectural furniture for, 100
 design of, 66
 equipment for, 363
 Dressing tables, 100
 Drips, 187, 373
 Drives, 281, 299
 Dumb waiters, 235
 Durability, 85
 Dynamos, 229

* E

Eaves. (*See* Cornices)
 Eccentric mouldings and ornament, 124
 Egyptian dwellings, 2
 Electric lamps, 262
 lighting, 258
 cost of, 350
 Electric machines, 229
 plants, 229
 wiring, 258
 Electricity, 257
 Electroplating iron, 167
 Elevations, grade, 295, 296
 in drawing, 356
 Elevators, dumb, 235
 Enamel, 168, 200
 Enameled brick, 140

Enameled iron, 273
 woodwork, 207
 Endogens, 146
 Engines, 229
 English architecture, 17
 character of, 128
 English cottages, 310
 gardens, 277
 Entablatures, 120
 Entasis, 120
 Entrance porches, 82
 Equipment of rooms, 361
 Erection of buildings, 174
 Escutcheons, 166, 373
 Estimating costs, 344
 Excavation, 177
 Exogens, 146
 Expanded metal lath, 193
 Expansion joints, 145
 Expansion tanks, 247
 Exterior design, 58
 finish, 187
 trim, 187

F

Fabrics, 226
 Farmhouses, appliances for, 229
 kitchens for, 76
 landscape gardening for, 279
 sites for, 48
 Farm sites, 48, 279
 Fees, architect's, 322, 339
 Fences, 289
 Finish, exterior, 187
 interior, 192
 Finish materials, 163
 Fire bricks, 139
 Fireplaces, 94, 241
 cost of, 351
 size of, 359
 Fireproof buildings, cost of, 345
 Fire protection, 41
 Fire stops, 193
 Fire Underwriters, 260
 Fitments, 314. (*See* Architectural Furniture)
 Fitting, gas, 255
 Five orders of architecture, 118
 Flashing, 169, 187
 Floor coverings, 226
 drains, 66

- Flooring, cost of wood, 350
 dimensions of wood, 167
 laying of, 198
 quarter sawed, 166
 under, 185
 Floors, basement, 180
 concrete, 145
 finish, 167
 tile, 170
 treatment of, 208
 wood, 167
 Flour bins, 112
 Flow of gas, 255
 water, 267
 Flower boxes, 84
 Flowers, arrangement of, 223
 planting of, 306
 Flowers in gardens, 293
 Flues, 96, 181. (*See* Chimneys)
 Foot baths, 275
 size of, 360
 Footings, 178
 Forces, hostile, 1
 Formal houses, 37
 Forms for concrete, 145
 Foundations, 177
 Fountains, 287
 Frame construction, 175
 Framing, 175, 182
 cost of, 349
 Freezing of water in pipes, 268
 Friezes, 120
 Frontage of lots, 42
 Fronts, garden and street, 31, 51
 Fuel rooms, 85
 Fuel windows, 237
 Furnaces, 241
 Furnishing, house, 218
 Furniture, architectural, 87, 94
 for bedrooms, 99
 for dining rooms, 102
 for kitchens, 104
 for living rooms, 94
 Furniture, arrangement of, 218
 selection of, 224
 Furring, 174, 373
 Fuses, 261
- G
- Gable, 373
 Galvanized iron, 160
 Gambrel, 373
 Games, 283
 Garages, 280
 Garbage, disposal of, 234
 Garden construction, 295
 design, 295, 297
 houses, 284
 Gardening, 277
 Garden structures, 283
 Gardens and grounds, 277
 Gardens, bog, 290
 formal, 277, 299
 informal, 277
 Japanese, 291
 rock, 291
 water, 290
 Gargoyles, 126, 287
 Gas, acetylene, 230, 255
 heating, 255
 illuminating, 255
 sewer, 270
 Gas fitting, 255
 cost of, 350
 Gas heaters, 232
 Gas pipes, 255
 sizes of, 256
 Gates, 84, 289
 Geometry of plan, 55, 87
 Georgian architecture, 20, 23.
 (*See* Colonial Architecture)
 Girder, 374
 Glass, 170, 200. (*See* Glazing)
 lead, 171
 plate, 170
 prism, 172
 ornamental, 210
 sheet, 171
 translucent, 172
 wire, 172
 Glass on hardware, 168
 Glazed bricks, 139
 Glazing, 200
 Globes, 253
 Glossary of architectural terms,
 359
 Gothic architecture, 12, 18, 21, 124
 Grade, 362
 Grade door, 374
 Grading, 177
 of gardens, 301
 Grain of wood, 147

INDEX

Granites, 133
Gravel, 145, 281
Greek architecture, 10, 21
Groove, tongue and, 196
Grounds, 194. (*See* Gardens)
Grout, 362
Grouting, 183
Gutters, 160, 188, 269

H

Hair plaster, 192
Halls, 58
 equipment for, 362
 rear, 78
 size of, 358
Hand rails, 58
Hangings, 226
Hard plaster, 208
Hardware, 160
 finish, 166
 putting on of, 198
Hardwoods, 147, 150
Hat shelf, 99
Headers, brick, 142
Hearths, 96, 181
Heat, 240
Heaters, 85
Heating and ventilation, 240, 248
Heights, ceiling, 88. (*See* Dimensions)
Hinges, 160
Hip roof, 129, 362
Hoists. (*See* Cranes)
Hollow tiles, 144, 174
Hoods for doors, 84
 ranges, 114
Hopper bins, 112
Hot air furnaces, 241
Hot water heating, 247
 cost of, 351
Hot water supply, 232
H-plans, 55
Humidity, 248

I

I-beams, 160
Illumination, 253. (*See* Lighting)
Incandescent lamps, 262
Incinerators, 234

Indications, conventional plan, 356
Individuality, 52
Informal houses, 37
Inglenooks, 98, 314
Inspection, work of, 328
Instantaneous gas heaters, 232
Instruments, drafting, 355
Insulating materials, 161
Insulation of attic rooms, 161
Interior decorations, 203
 design, 87
 finish, 192
 woodwork, 91, 195
Ionic order, 122
Iron, 160
 enameled, 273
Iron finishes 167

J

Jambs, height of head, 90
 plaster, 316
Japan finish for hardware, 167
Japanese influence, 36
Joining, 196
Joints, brick, 142
 expansion, 145
 stone, 138
 wood, 196
Joists, 182

K

Kitchen design, 70
Kitchen for a farmhouse, 76
 the large suburban house, 74
 the very small suburban house, 72
Kitchens, architectural furniture for, 104
 decoration of, 214
 design of, 70
 equipment for, 35
 plumbing for, 275
 size of, 70, 358
Knobs, door, 166
Knots, wood, 148

L

Lake dwellings, 2
Lamps, 253
 electric, 262

- Landscape architecture, 277, 283
 gardening, 277
 Lathing, 192, 194
 Lathe, 184
 Lathe and plaster, 192
 Lattices, 84
 Laundries, 78, 358
 Laundry machines, 236
 tubs, 275
 Lavatories, 102, 274, 360
 Lawns, 292
 Lead pipe, 267
 Lean-to, 374
 L'Enfant, 320
 Libraries, design of, 62
 equipment for, 363
 size of, 358
 License, architect's, 321
 Lifts, 235
 wood, 115
 Light, 251. (*See Daylight*)
 artificial, 252
 diffusion of, 253
 Lighting, 251
 electric, 258
 gas, 255
 Lighting fixtures, 263
 Lime, 163
 Lime mortar, 164
 Limestones, 133
 Line, 117
 Line, building, 176
 Line, center. (*See Axes*)
 Linen closets, 68, 100
 Linoleum, 226
 Linseed oil, 168
 Lintels, 1, 375
 Living apartments, 62
 Living rooms, architectural furniture for, 94
 arrangement of furniture for, 219
 decoration of, 212
 design of, 62
 Living rooms, equipment for, 362
 size of, 346
 Lockers, 198
 Locks, 166
 Log cabins, 23, 28
 Loggia, 363
 Lots. (*See Sites*)
 Louvre, 375
 L-shapes, 87
 Lumber, preparation of, 148. (*See Wood*)
 Lumens, 263
 M
 Mansard roof, 129
 Maps, contour, 296
 Marble plumbing fixtures, 273
 Marble slabs for kitchens, 112
 Marbles, 134
 Masonry, 174, 177, 181, 348
 Mass, 117
 Masses, 56
 Materials, building, 133, 163
 decorative, 206
 English cottage, 316
 garden, 279
 planting, 302
 Materials for drives and walks, 281
 plumbing fixtures, 273
 Medicine cabinets, 66, 102
 Meeting-rail, 375
 Metal lathe, expanded, 193
 Metal, ornamental, 211
 Metal paint, 168
 Metals. (*See Iron, Brass, Bronze, etc.*)
 Middle class cottages, English, 311
 Milk boxes, 237
 cupboards, 115
 rooms, 78
 Mineral wool, 161
 Mirrors in china cupboards, 102
 wardrobes, 100
 Mission style, 35, 128
 Mitre, 375
 Modillions, 122
 Monoliths, 2
 Monticello, 32
 Mortar, 163
 Mortise and tenon joints, 196
 Mouldings, classical, 117
 eccentric, 124
 Gothic, 124
 nailing of, 197
 sanitary, 130
 Moulds. (*See Mouldings*)
 Mount Vernon, 34
 Mullions, 316

INDEX

Museums, 62
 Music rooms, 62, 358
 Mutules, 121

N

Nails, 160
 Newel-post, 363
 Nurseries, 68, 375

O

Offices, 62
 Orders of architecture, 118
 use of, 123
 Oriental rugs, 226
 Ornament, 58, 124
 Ornamental glass, 210
 Owner, 321

P

Paint, 168
 Painted woodwork, 207
 Painting, 199
 cost of, 351
 Palaces of Rome, 10
 Paneling, 92
 Panels, 92
 Pantries, equipment for, 362
 pass, 72, 74, 358
 storage, 74, 76, 78
 Paper, building, 160, 186. (*See*
 Wallpaper)
 Parlors, 62
 Parquetry, 375
 Passages, size of, 358. (*See* Halls)
 Pass cupboards, 72, 74, 103
 pantries, 72, 74, 103
 Pastimes, children's, 283
 Pavements, 41
 Paving bricks, 139
 Pedestals, 120
 Pediment, 375
 Pergolas, 84, 286
 Persian architecture, 8
 Perspective, 356
 Piano cases, 98
 Pianos, size of, 360
 space for, 62
 Picture moulds, 92
 Pictures, 220
 Pigments, 168, 195

Pilaster, 364
 Piles, 177
 Pipes, gas, 255. (*See* Conduits)
 sewer, 270
 water, 267
 Plans, definition of, 344
 geometry of, 55
 types of, 51
 Planting, 302
 Plaster, 192
 cost of, 350
 materials for, 163
 Plaster of Paris, 208
 Plastering, 192
 back, 193
 Plate glass, 170
 Plate rails, 104
 Plates, 183
 Play rooms, 85
 Plenum, 243
 Plinth, 376
 Plot of a survey, 296
 Plumbing, 267, 350
 Police protection, 41
 Problems in design, 364
 Pointing, 138, 142
 Porcelain, 273
 Porches, decoration of, 216
 design of, 82
 dining, 80
 kitchen, 82
 living, 84
 size of, 358
 sleeping, 64
 two-story, 84
 width of, 84
 Portico, 10, 129
 Portland cement, 144, 164
 Posts, cast iron, 160. (*See* Col-
 umns)
 Power, 229
 Prehistoric structures, 2
 Pressure of gas, 255
 Pressure of water, 267
 Primitive dwellings, 3
 Prism glass, 172
 Profile map, 296
 Proportion, 55, 87
 Public utilities, 41
 Pumps, 288
 Pyramids, 2, 20

Q

Quilts, deadening, 160
Quoins, 138

R

Radiation, 245
Radiators, 245
Rafters, 184
Rails, 92
Raked out joints, 138, 142, 289
Range, size of, 360
Rebate, 376
Reception rooms, design of, 60
 equipment for, 363
 size of, 358
Red lead, 168
Reflectors, heat, 98
 light, 253
Refrigerators, 234
Registers, 242
Reinforced concrete, 145
Renaissance architecture, 18
Restfulness, 212
Reveal, 376
Ribbons, 184
Risers, 347, 376
Rock gardens, 291
Roman architecture, 10
Romanesque architecture, 12
Roofs, construction of, 184
 coverings for, 187
 kinds of, 129
Rubble, 136
Rugs, 226
Rustic siding, 186

S

Safes, 239
Sand, 145, 164, 195
Sandstones, 134
Sash, window, 88
Sawing of wood, 147
Scale, 58
Scales, 355
Screens, 196, 197
Screws, 160
Scrolls, 122
Sculleries, 312
Sculpture, 124
Seasoning of timber, 150

Seat baths, size of, 360
Seats, fireplace, 98
 garden, 288
 window, 98, 359
Sections, definition of, 356
Septic tanks, 272
Servants, rooms for, 82, 85
Service cupboards, 72, 74, 103
 pantries, 72, 74
 tables, 104
Sewage, 270
Sewer gas, 270
Sewers, 270
Sewing rooms, 64
Shades, lamp, 253
 window, 252
Shafts, 120
Shakes, 148
Shale, 136
Sheathing, 185
Sheathing paper, 160, 186
Sheet glass, 171
 metal, 160
Shellac, 168
Shelter, 1, 23
Shelters, 284
Shelves, 108, 359
Shingles, 186, 187
Shiplap, 185
Shoe mould, 91
Shops, 67, 85
Showers, 275, 360
Shrinkage, 150, 196
Shrubs, 292, 304
Sideboards, 102
Side lights, 88
Siding, lap, 186
Sill, 364
Sills, 182
 inside window, 92
 outside window, 187
Sinks, kitchen, 72, 76, 114, 275
 pantry, 275
 slop, 275
 size of, 360
Sites, building, 40
Sizes. (*See* Dimensions)
 of bricks, 142
 of gas pipes, 256
 of water pipes, 267
Slates, 135

INDEX

Sleeping apartments, 64
 porches, 64
 Sleeper, 377
 Slope of ground, 45
 Smoke stacks, 181, 185
 Smoking rooms, 62
 Soapstone, 136, 273
 Soffit, 377
 Softwoods, 147, 155
 Soil pipes, 270
 Soils, 43, 301
 Spanish architecture, 34
 Specifications, 176
 Spouts. (*See* Downspouts)
 Spring line, 377
 Stacks. (*See* Chimneys)
 Staff, 208
 Staining, 199
 Stains, 168
 Staircase, Colonial, 128
 Stairs, 359
 Stairways, 58
 width of, 358
 Staking out the building, 176
 Statues, 287
 Steam heating, 243
 cost of, 351
 Steel, 160
 Stepping stones, 282
 Steps, inside, 88
 garden, 282
 size of, 359
 Stiles, 92
 step, 289
 turn, 289
 Stone facing, 136
 joints, 138
 Stones, building, 133
 Stonework, 137
 Stools, kitchen, 104
 window, 92
 Stoops, 84
 Storage pantries, 74, 76, 78
 Store rooms, 68
 Stoves, 240. (*See* Ranges)
 Streets, 41
 Stretcher, 377
 Stucco, 193
 Studding, 183, 377
 Studs, 183
 Styles of architecture, 7, 36

Stylobate, 121
 Suburban houses, 37, 62, 72
 lots, 44
 Summer houses, 284
 Sun dials, 287
 Sunshine, 251
 in the kitchen, 70, 251
 Superposition of the orders of architecture, 123
 Surveys, 295
 Switches, 260
 Symbols. (*See* Conventional Indications)
 used on maps, 297

T

Tables, height of kitchen, 104,
 359
 size of dining, 360
 size of reading, 360
 Tanks, hot water, 232, 268
 house or storage, 268
 Tea houses, 284
 rooms, 62
 Telephones, house, 235
 Temperature, 249
 Terms, architectural, 358
 glossary of architectural, 371
 Terraces, 298
 Terra-cotta, 143, 170
 Terra-cotta tile, 144, 174
 Texture of bricks, 140
 Tiles, 143
 drain, 143, 269
 face, 169
 floor, 170
 ornamental, 210
 roof, 143
 sewer, 144
 terra-cotta hollow, 144, 174
 Tiles for plumbing fixtures, 273
 Timber. (*See* Wood and Lumber)
 Tin, 160
 Toilet cases, 102
 Toilet rooms. (*See* Lavatories and Bathrooms)
 Tongue and groove joints, 196
 Topographical drawings, 296
 Topography, 278

Towel closets, 66, 100, 102
 Towns, origin of, 16
 southern Colonial, 31
 T-plans, 55
 Transoms, 88
 Transportation, 41
 Traps, 270
 grease, 271
 Tread, 377
 Treads, width of, 359
 Trees, garden, 292
 growth of, 146
 planting and care of, 304
 value of, 43
 Trellises, 84
 Triangles, 355
 Triglyphs, 121
 Trim, exterior, 187
 interior, 91, 195
 Trimmer, 377
 Trunk rooms, 68
 T-squares, 355
 Tufts, 136
 Tumuli, 2
 Turnstiles, 289
 Tuscan order, 120

U

Under flooring, 185
 Uniform contract, 323
 Units in design, 55, 56
 Urns, 288
 Utilities, house. (*See Devices*)
 outdoor, 280

V

Vacuum cleaners, 233
 Valley, 377
 Varnish, 168
 Varnishing, 199
 Vases, flower, 223
 garden, 288
 Vaults, 239
 Vegetable rooms, 85
 Veneer, brick, 174, 186
 Ventilation, 240, 248
 Vent pipes. (*See Ventilation*)
 Vents, in plumbing, 270

Verandas. (*See Porches*)
 Verge board. (*See Barge Board*)
 Vermin proof bins, 112
 walls, 193
 Villas of Rome, 11
 Vines, 304
 Vistas, 279, 290, 307
 Vitreous ware, 273

W

Wainscot, 92, 98
 Wainscoting, 92, 98
 Walks, 281, 299
 Wallpaper, 209
 Walls, garden, 288
 masonry, 181
 Wardrobes, 64, 99
 Warping, 150, 196
 Wash basins. (*See Lavatories*)
 Wash-up rooms, 78
 Waste pipes, 270
 Water closets, 274
 size of, 360
 Water consumption, 267
 gardens, 290
 in the garden, 290
 pipes, 267
 Waterproofing of foundation walls
 180
 Water supply, 231, 267
 Water-tables, 187
 Water wheels, 229
 Wells, 288
 White lead, 168
 Wind breaks, 279
 Windmills, 229
 Window frames, 187
 Windows, 88, 197, 251
 cost of, 351
 English cottage, 316
 size of, 359
 Window seats, 98
 Wire, electric, 258
 Wire glass, 172
 Wiring, electric, 258
 Wood, 146
 cost of, 349
 Wood, growth of, 246
 preparation of, 148
 sawing of, 147

INDEX

Woods, seasoning of, 150
Wood joints, 196
 treatments, 206
Woods, finish, 165
 hard, 147, 150
 imported, 158

 soft, 147, 155
Working drawings, 323

Z

Zinc for bin linings, 112

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